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SCIENCE OUTLOOK

Academy of Sciences Malaysia

Unlocking the Future

SCIENCE OUTLOOK 2020

Unlocking the Future

AKADEMI SAINS MALAYSIA

Science Outlook 2020 - Executive Summary V2
Unlocking the Future

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FOREWORD

Professor Emerita Datuk Dr Asma Ismail FASc
President, Academy of Sciences Malaysia

In the 26 years of its establishment, the Academy of Sciences Malaysia (ASM) has built its name as the nation's thought leader in matters related to science, engineering, technology and innovation. One of the Academy's key objectives is to galvanise the science, technology, and innovation (STI) agenda as an accelerator of Malaysia's development into an agile and competitive high-tech nation.

We do these through our strategic advisory inputs and advocacy to the Government and other STI partners. Among them is the Science Outlook, which is one of ASM's flagship reports that provide evidence-based insights of Malaysia's STI landscape. The findings and recommendations of this biennial report are highly regarded at national and international levels to inform policymakers on strategic alignments of STI policy frameworks and the nation's interest. The first edition was launched in 2015 followed by the second edition in 2018.

The Science Outlook 2020: Unlocking the Future may be the third edition of this flagship report but it is a trailblazer document on many fronts. This is the first Science Outlook report that has adopted the ecosystem approach to scan Malaysia's progress in terms of economic development, societal well-being as well as environmental conservation and sustainability through the lens of STI, in the last thirty years. It is the first report to evaluate the challenges outlined in Vision 2020 from the STI perspective – for Malaysia to become a socially cohesive and developed country and chart the STI progress and development in the country since the Vision was launched. We take pride that the Science Outlook 2020 is the first ASM report to include growth trajectory modelling and strategic foresighting to future-proof Malaysia's STI policy development and implementation. The report's findings have been calibrated against national STI strategies and the United Nation's 2030 Agenda for Sustainable Development Goals to assess the nation's sustainable development approach.

Although we have made the most of our strengths to advance the nation, the STI ecosystem gaps identified in this report have contributed to Malaysia falling short of achieving the ideals of Vision 2020. The ripple effects arising from the gaps have widened socio-economic inequities and allowed unchecked damage to the environment. Malaysia is part of the open market which means we must deal with multiple pressures from the tech-driven global economy; the lacklustre STI ecosystem can endanger the progress we have made on many aspects.

For Malaysia to become an advanced nation by 2030, we need systemic changes across the board. All stakeholders – from the Government to researchers to businesses, civil society organisations to individuals – are part of institutions that make up the STI ecosystem that nurture Malaysia's progress. Everyone has a vested interest to engage in the Whole-of-Government and Whole-of-Society endeavours to reorientate and strengthen the nation's STI ecosystem so that we can achieve the Shared Prosperity Vision 2030 aspirations with no one left behind.

On behalf of ASM, I would like to thank all ministries, agencies, industry partners, civil society organisations, professional bodies, and the numerous individuals who have unstintingly shared data and ideas that made this study possible. Warmest congratulations and a big thank you to the Science Outlook 2020 team led by Professor Dato' Ir Dr Mohd Saleh Jaafar FASc along with the Deputy Chair, Professor Dr Nik Meriam Nik Sulaiman FASc and the pillar Chairs: Professor Dr Mahendhiran Sanggaran Nair FASc on Economic Impact Pillar, Professor Dr Rofina Yasmin Othman FASc on Societal Impact Pillar and Dr Helen Nair FASc on Environmental Impact Pillar. Highest appreciation also to all Working Group Members; the ASM Management; and all the analysts for your hard work and commitment, going beyond the call of duty in producing this report.

I hope that the analyses and recommendations of Science Outlook 2020: Unlocking the Future will feed the efforts to mainstream STI and consolidate the ecosystem toward Malaysia becoming a high-tech nation by 2030. ASM welcomes subsequent dialogue with stakeholders on the findings and recommendations of this report.

PREFACE

Professor Dato' Ir Dr Mohd Saleh Jaafar FASc, FIEM, F.APM
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The transformative power of science, technology, and innovation (STI) on life in the 21st century is undeniable; from propelling the economy to influencing social progress, as well as providing the solution for conserving the environment for the future. Harnessing STI for positive outcomes require all key players to operate collectively in harmony, creating an ecosystem where STI and the economy (STIE) are interlinked together. In order for Malaysia to shift from an upper-middle income into a high-income economy, the nation must have a robust STIE ecosystem that is responsive rather than reactive, flexible and dynamic in the face of uncertainties and disruptions in the global economy. The optimised STIE ecosystem encourages talent, creativity, and innovation to intensify Malaysia's competitiveness in the knowledge economy, and calls for ministries, agencies, business entities, civil societies, and assorted partners to work together collaboratively in this ecosystem to achieve the aspirations of the Shared Prosperity Vision 2030.

Science Outlook 2020: Unlocking the Future is the latest of the Science Outlook series that provide evidence-based review of STIE in Malaysia. This edition adopted a challenging framework to examine STIE progress and development in Malaysia from the inception of Vision 2020 in 1991 up to year 2020. The ecosystem approach of this report analysed the inputs, outputs, outcomes, and impact of STI on the economic, societal, and environmental dimensions of the country for the past 30 years to come up with the way forward to unlock an inclusive, prosperous, and sustainable future for Malaysia.

The study was carried out by three Working Groups: Economic Impact Pillar, Societal Impact Pillar and Environmental Impact Pillar, headed by Professor Dr Mahendhiran Sanggaran Nair FASc, Professor Dr Rofina Yasmin Othman FASc and Dr Helen Nair FASc, respectively. Each Working Group was made up of subject matter experts, with the support of ASM analysts and research assistants for data gathering and synthesis.

Numerous national documents such as Malaysia Plans, policies, miscellaneous national plans, blueprints, and roadmaps were reviewed and cross-referenced against hundreds of peer-reviewed publications and data compiled from relevant agencies. The output was compared against global benchmarks followed by global best practice analyses to determine Malaysia's position. Unlike the previous editions, this study employed a sequential mixed-methods approach which consist of qualitative and quantitative research elements, where the findings from the qualitative stage helped the development of the path model for the micro-level analysis.

The views and recommendations presented in this report are evidence-based; supported by verified primary and secondary data, case studies, and interviews with relevant stakeholders. I would like to thank Professor Dr Nik Meriam Nik Sulaiman FASc, who helped to guide the study as Deputy Chair, as well as the Working Group Chairs, Working Group Members, industry practitioners, analyst team and Editor, as well as the graphic designers for their efforts in making Science Outlook 2020 possible. It is hoped that this reflection of the state of STIE in our country for the last 30 years will become a reference that will transform the STIE ecosystem in Malaysia.

We wish to also thank ASM for the trust given to us to conduct this study and everyone who helped make this report possible.

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EXECUTIVE SUMMARY

Malaysia has successfully diversified its economy into one of the most open economy in the world, underpinned by a robust manufacturing and service sectors. The growth was also made possible by the strengthening of the Science, Technology and Innovation (STI) ecosystem over the last three decades that reshaped the global landscape, opening borders and markets in unprecedented ways. Malaysia's readine readiness to take up STI advances contributed to the nation's rapid transformation during this period, building upon the stable growth laid by visionary policies to make Malaysia one of Southeast Asia's success stories.

The rigors of the modern economy demand the prioritisation of STI for everyone; from individual citizens to the Government machinery, including for-profit and non-profit entities. The mechanisms supporting the nation's STI capability are the linchpins of its STI strategies; the modality must have indicators for systematic measurement of STI performance and forecasting potential prospects using evidence-based feedback. The STI networks to advance Malaysia's STI capability demand dynamic talent, agile industries positioned for growth and innovation, sound financial institutions, as well as transparent and robust regulatory architecture.

Today, the progress of a nation is not only measured by gross domestic product (GDP) or national expenditure, but it is just as much about ensuring the overall quality of life and well-being of its citizens. A successful country also makes sure that the growth of today is not at the expense of the future generations. As Malaysia strives to become a developed nation that is united, prosperous, inclusive, and sustainable, it is important to reflect on the successes and failures of domestic STI policies that served as the nation building foundation on the economic, societal, and environmental pillars (Figure 1.1).

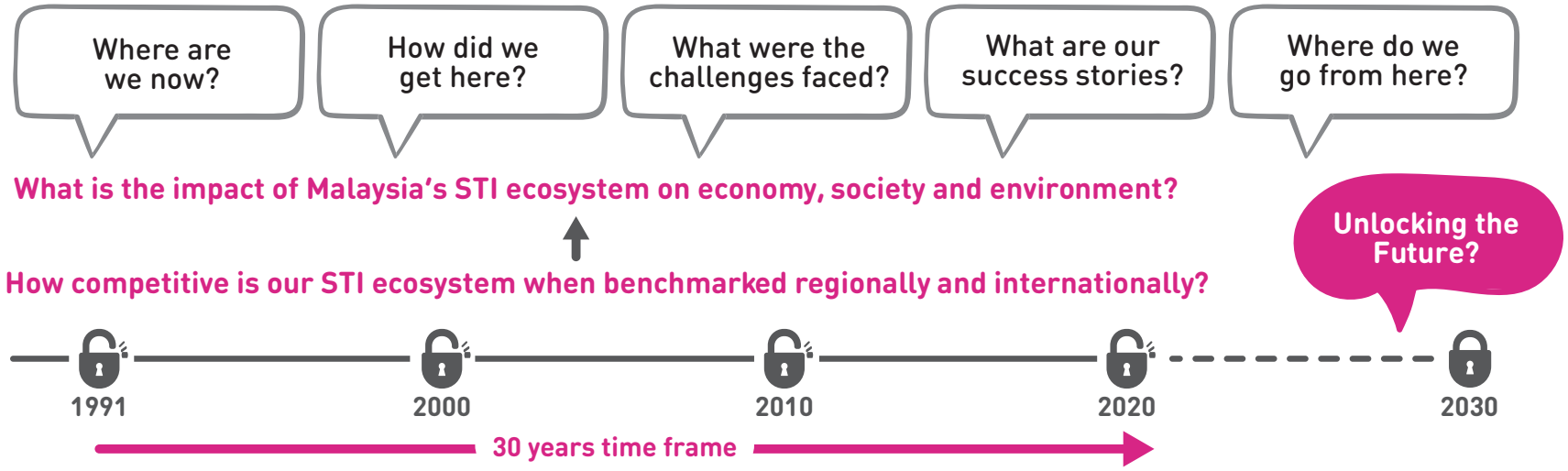

Figure 1.1: Three Decades of STI Evolution

About the Science Outlook

Science Outlook is one of Academy of Sciences Malaysia's (ASM) flagship studies. Its aim is to present insights based on relevant data on Malaysia's STI landscape – on how to increase the use and adoption of STI and to transform the coordination of STI policies as part of the efforts to mainstream STI at all levels in the country. These efforts are needed to catalyse the nation's productivity, enhance competitiveness, and promote inclusive growth to realise Malaysia's aspiration of becoming one of the top innovation-led nations in the world.

ASM's Science Outlook was initiated in 2013 with its first report the Science Outlook 2015 – Action towards Vision (SO2015) launched in 2015. This evidence-based independent review on key STI trends in Malaysia was specifically introduced as a yardstick for Malaysia's performance. Response to SO2015 indicated the necessity to keep a finger on the pulse of national STI trends at local, regional and global levels to assess possible future implications; hence a biennial review was proposed. The second report, Science Outlook 2017 – Converging towards Progressive Malaysia 2050 (SO2017) was launched in 2018. 18 recommendations were proposed in each edition, of which 11 and 10 were successfully considered and implemented either partially or fully in SO2015 and SO2017 respectively. The progressive outcomes of SO2015 and SO2017 are outlined in the pull-out section of the main report. Figure 1.2 illustrates the philosophy guiding the Science Outlook reports.

Science Outlook 2020 – Unlocking the Future (SO2020) explores STI progress in Malaysia since the declaration of Vision 2020. This report probes selected STI-related indicators and the impact of national-level programmes, frameworks, and initiatives from the year 1991 to 2020. This data is used to identify the strengths and shortfalls of the present STI ecosystem (see Chapter 6) and how the ecosystem can be stimulated to boost Malaysia's sustainable growth into a high-income nation.

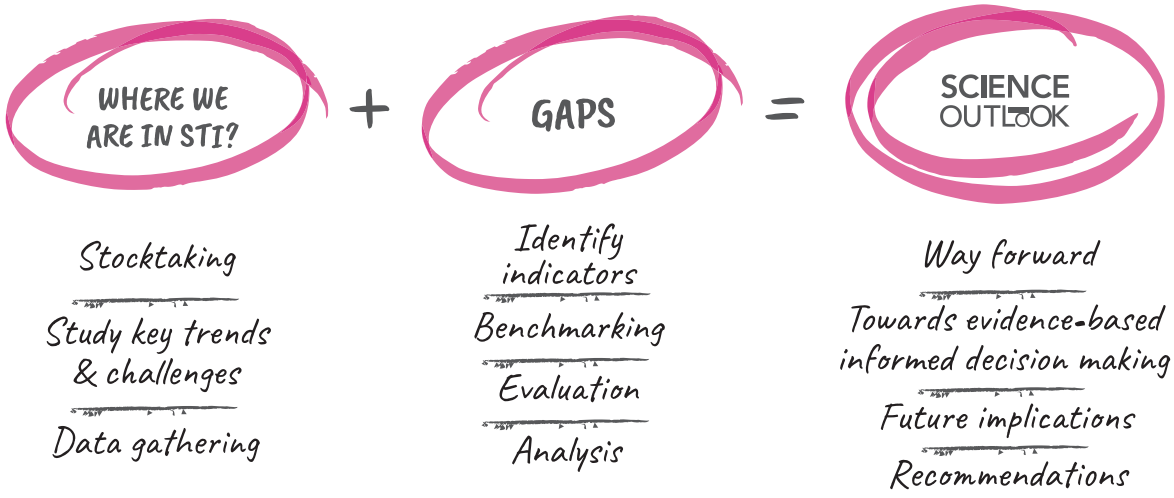

Figure 1.2: Philosophy of the Science Outlook

Objective

SO2020 examines the impact of STI on the economic, societal, and environmental outcomes for Malaysia since the inception of Vision 2020. The approach of this report is beyond auditing the current progress towards evaluating the steps and possible development trajectory to ensure that Malaysia is able to reach its goals and aspirations as defined in the Shared Prosperity Vision 2030 (SPV2030).

Scope and Conduct of the Report

SO2020 employed a mixed methods approach to assess the Malaysian STI ecosystem. The mixed methods research entails using qualitative and quantitative research approaches to draw a comprehensive understanding of the industry, public and the key stakeholders' perspectives. This data was used to forecast the nation's growth trajectory towards becoming a high-income nation by 2030, as encapsulated by the SPV2030.

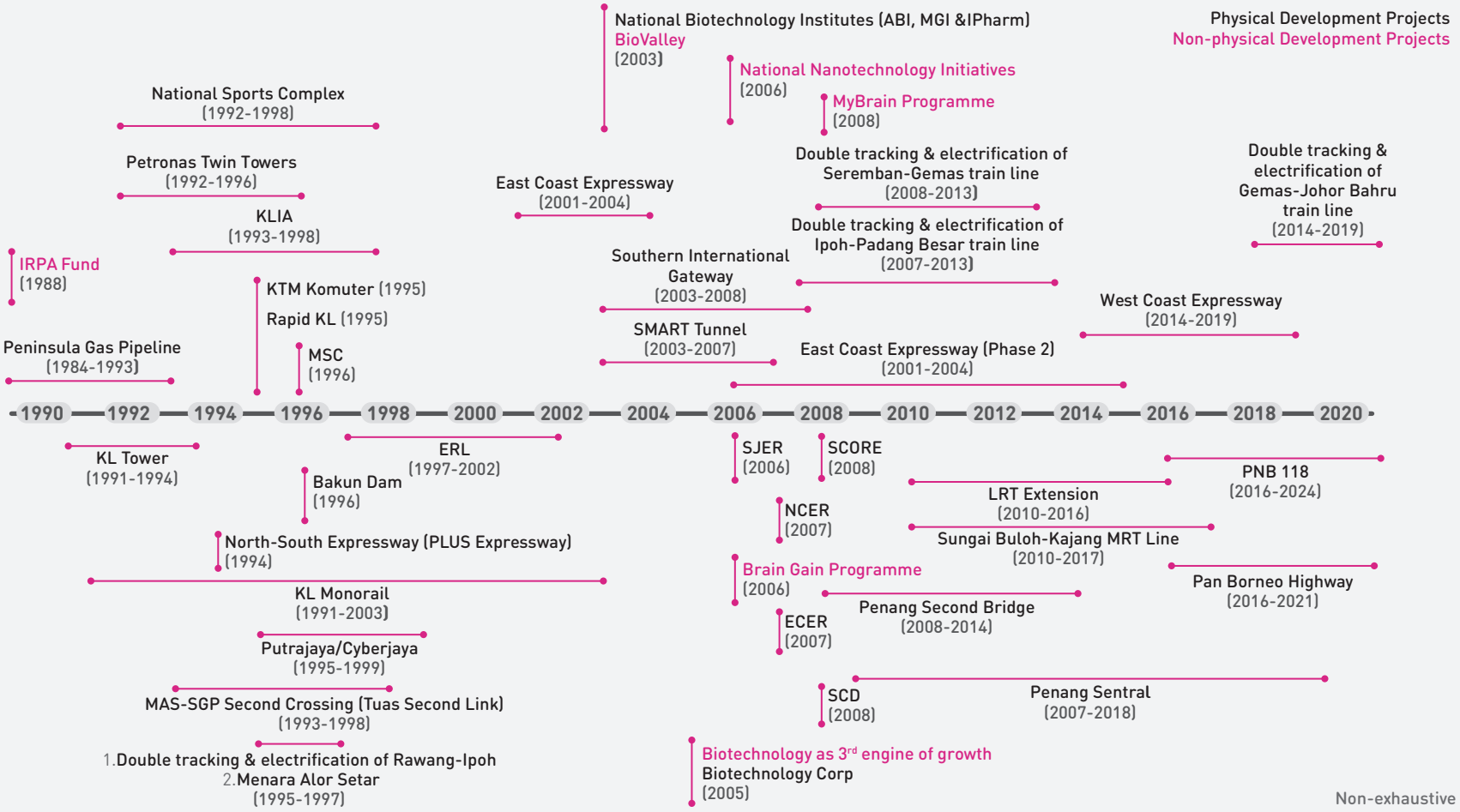

Figure 1.3: Three Decades of National Projects

STI Policies for Inclusive and Holistic Growth

Infrastructure development was determined to be the engine of growth and capacity building for Malaysia and this approach was ramped up since the 1980s. The new roads that opened up the country also helped make it safer against the Communist insurgency that was only laid to rest by the peace accord signed in 1989. The incidence of poverty dropped dramatically when the land-poor was given opportunities to participate in the palm oil boom; such development in remote areas was made possible with the expansion of access to utilities such as piped water, electricity, and telecommunication. This trend continued in the 1990s onwards with many national infrastructure developments (Figure 1.3) serving as the cornerstone of the country's economic expansion and preparing Malaysia to be globally competitive.

Focus on capacity building in research and development (R&D) began in earnest in the 1990s with the establishment of the Intensified Research Priority Area (IRPA) funding to foster research and development (R&D) in public universities and research institutions. It laid the groundworks for the Malaysian Research Universities (MRUs) in 2007 which helped intensify the country's R&D outputs. The Brain Gain Programme in 2006 was initiated to coax Malaysian STI talents who had established expertise abroad to return home and share their knowledge and skills. This was also supported by the MyBrain Programme two years later to increase the number of highly qualified and well-trained research personnel through education investment both locally and overseas. However, funding for both programmes had shrunk since their inception; other issues related to research personnel in the country are discussed at length in Chapter 2.

The Government's five-year Malaysia Plan (MP) provides a framework for national medium-term socio-economic policies while the long-term planning is mapped out by the Outline Perspective Plans (OPP) to optimise resource mobilisation. These policies had to be adjusted periodically in response to global and local events (Figure 1.4).

The first major adjustment was with the formulation of the New Economic Policy, an affirmative action programme to address the economic inequalities. The plan was to increase Bumiputera economic equity to 30% through social re-engineering and preferential access to education. It was then replaced by the National Development Policy, the National Vision Policy, the New Economic Model, and now, the SPV2030, all of which shared the same focus: i.e., restructuring the economy for a fair and equitable distribution of the nation's wealth across the population.

While there were a number of policies introduced, these policies were unable to systematically address the socio-economic gaps in the country. These gaps highlight those policies that target wealth inequalities and promote social mobility must be needs-based. Rapid transformation of the Malaysian economy will require continuous review and assessment of poverty indicators and other social well-being measures (see Chapters 3 and 4 for more details).

The prologue of the **Rukunegara** (1970):
- Achieving a more **perfect unity** amongst the whole of society;
- Preserving a **democratic way** of life;
- Creating a **just society** where the **prosperity** of the country can be **enjoyed together** in a fair and equitable manner;
- Guaranteeing a **liberal approach** towards our traditional heritage that is rich and diverse;
- Building a **progressive society** that will make use of science and modern technology.

New Economic Policy (NEP) (1971-1990):
Objectives:
- To achieve **national unity**, harmony and integrity through **socio-economic restructuring** (of the society)
- To minimise the level of **poverty** in the country

Vision 2020 (1991-2020)
Objectives:
- To transform Malaysia into a **high-income economy and a fully developed country** by year 2020.
- To establish a united Malaysian nation made up of one **'Bangsa Malaysia'** with political loyalty and dedication to the nation.

National Development Policy (1991-2000)
- Introduced with the objective of **achieving economic growth, while ensuring that accrued benefits reach all sections of society**.
- Replaced the New Economic Policy (NEP) but continued to pursue most of the affirmative actions of NEP.

National Vision Policy (NVP) (2001-2010)
- An extension policy of National Development Policy
- To establish a **united, progressive and prosperous 'Bangsa Malaysia'** that live in harmony and engages in full and fair partnership.
- Key strategies of NVP is to **eradicate poverty irrespective of race**, restructuring society and balanced development.

New Economic Model (NEM) (2011-2020)
- An economic plan which is intended to double the per capita income in Malaysia by 2020.
- Strategies include the Government Transformation Plan (GTP) and Economic Transformation Programme (ETP).

Shared Prosperity Vision (2021-2030)
- To restructure the economy to be more progressive
- **To address economic disparities** across income, regions and ethnicities
- To build a **united, prosperous Malaysia**

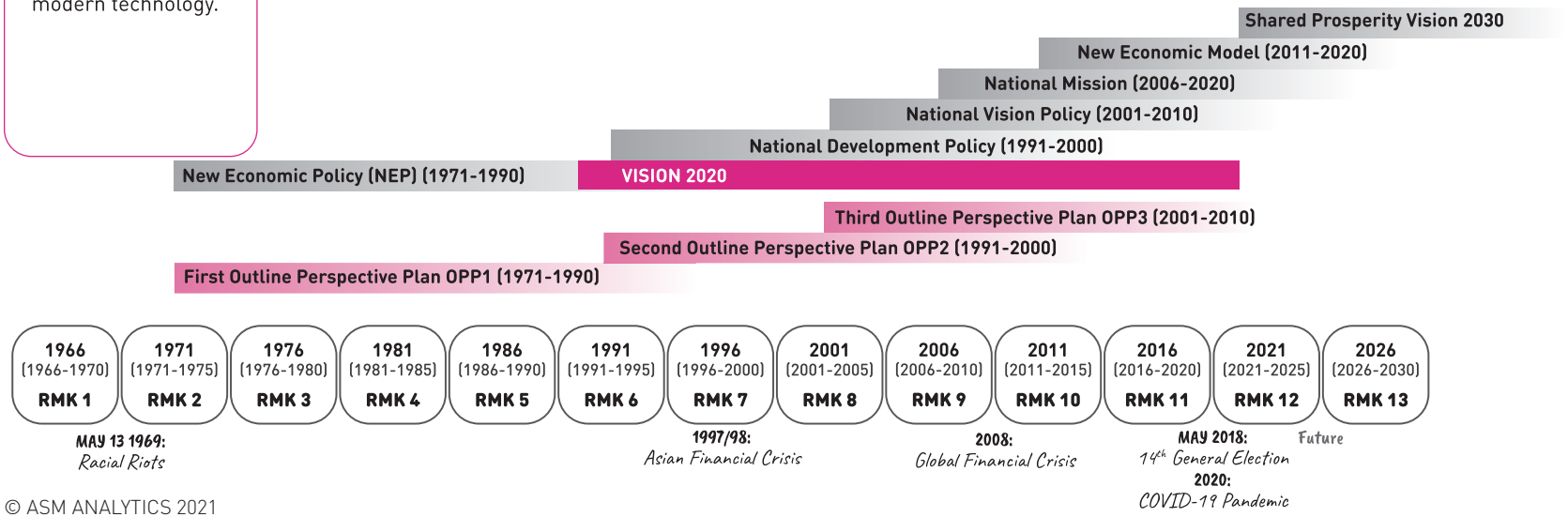

Figure 1.4: Key Development Policies and Plans

Vision 2020 defined Malaysia's aspirations to be a high-income developed economy across all economic, political, social, spiritual, psychological, and cultural dimensions by year 2020. The Vision expanded the idea of *'Bangsa Malaysia'* as the cornerstone of a united Malaysian nation and emphasised technological, social, and environmental advancement for Malaysia to ensure a balanced development.

The ideals of Vision 2020 had inspired not just Malaysians, but also admirers from abroad who saw Malaysia as a model for developing nations to progress in a holistic manner. Six out of the nine challenges centre around the humanistic aspect of nation building and societal progress. As seen in Figure 1.5, many aspects of the Vision such as unity, diversity and biodiversity were not realised due to inconsistencies between economic and social engineering policies. Analyses of the Malaysia's performance in the various Vision 2020 challenges are articulated in the pull-out section.

The conservation of the environment and maintenance of Malaysia's natural capital were not given adequate priority compared to other development initiatives. Weak enforcement, insufficient resources for protecting the environment, and unfettered industrial development has made the country vulnerable to risk arising from climate change and global warming. Chapter 5 of this report explores this theme more thoroughly.

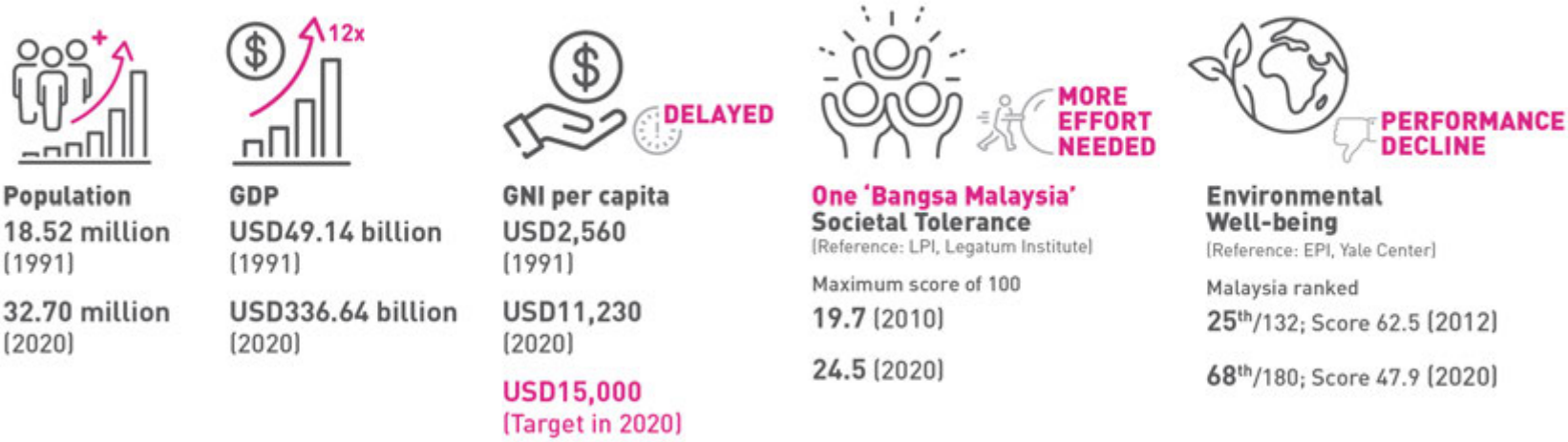

Figure 1.5: Envisioning Vision 2020

Key STI Indicators Performance

Over the years, Malaysia has shown commitment to developing and leveraging on STI to drive its trajectory towards becoming a developed and prosperous nation. Several key STI indicators have been selected to assess the country's STI performance, i.e., research expenditure, personnel, and productivity as well as the impact of the country's STI ecosystem on Malaysia's socio-economic development.

Malaysia's gross expenditure on R&D (GERD) expanded from 2006 until 2016 but fell sharply to an 8-year low of 1.04% GERD per GDP in 2018, after the watershed general election (Figure 1.6). This drop is expected to affect the other STI indicators which can hamper Malaysia's target to become a robust knowledge economy by 2020. Malaysia has done well in maintaining a healthy percentage of GERD per GDP compared to developing nations but performs poorly in this aspect when contrasted against developed countries like the Republic of Korea, Sweden, Japan, Germany, and Denmark which have surpassed 3% of GERD per GDP. The National Policy on Science, Technology & Innovation (NPSTI) 2021-2030 outlined a target of 2.5% GERD per GDP by 2025 and 3.5% GERD per GDP by 2030; however, this may be tough to accomplish given the present economic disruption caused by the COVID-19 pandemic.

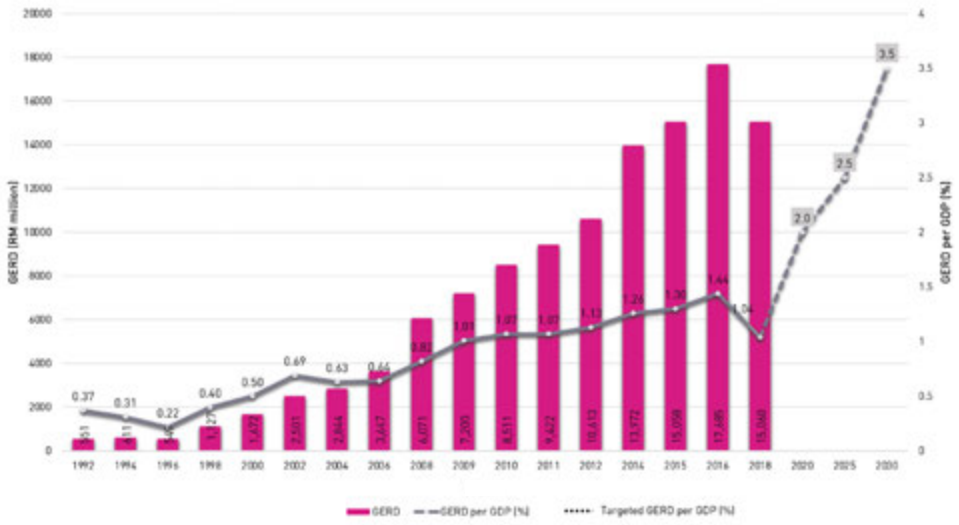

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Figure 1.6 (a): Malaysia's Gross Expenditure on Research and Development (GERD)

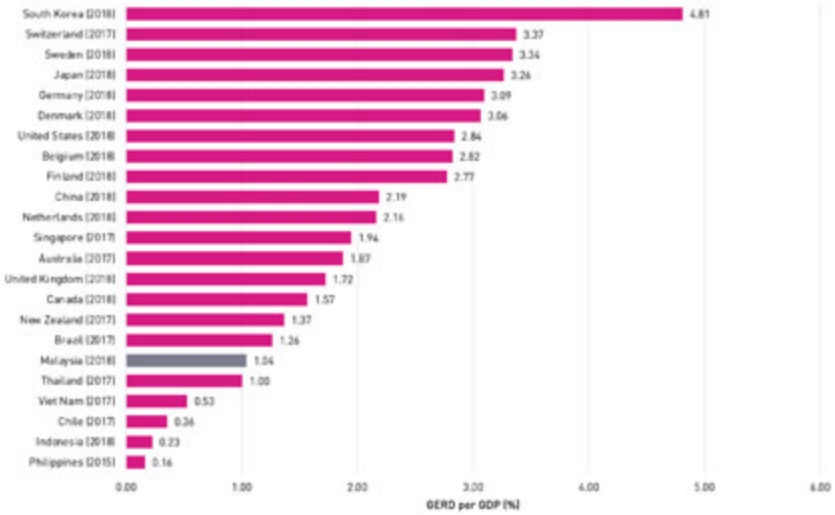

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Figure 1.6 (b): Benchmarking on Gross Expenditure on Research and Development (GERD) in 2018

The number of research personnel in Malaysia has been increasing since the implementation of the My Brain Gain and MyBrain programmes as well as the MRUs in the mid-2000s. Malaysia's number of full-time equivalent researchers (FTE) per thousand labour force is 4.5 FTE/1000
labour force (Figure 1.7) which is ahead of other developing countries but still lags behind developed countries. The largest number of researchers are in public universities and government research institutions, unlike advanced economies where they have a higher proportion of researchers in the business sector (Figure 1.8). The hesitancy of Malaysia's business sector to invest in research, development, commercialisation, and innovation (RDC&I) is a major stumbling block of building the resilience and capacity needed for the country to move up the value chain as a knowledge economy.

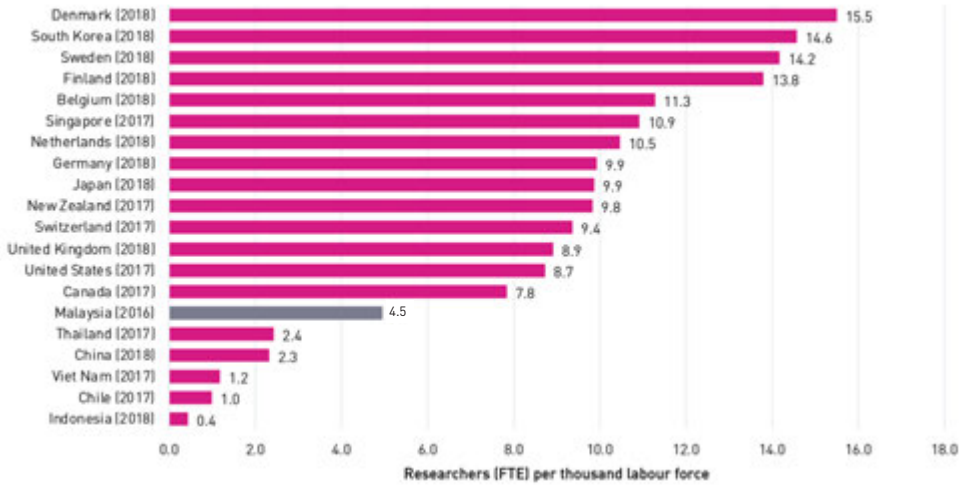


Figure 1.7: Global benchmarking of Researchers (FTE) per Thousand Labour Force in 2018

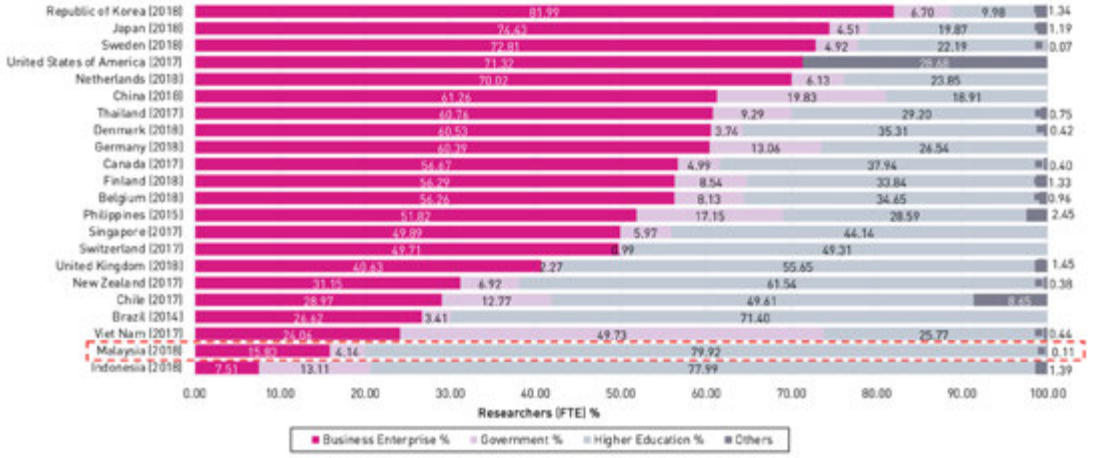


Figure 1.8: Global Benchmarking of Researchers (FTE) by Sectors in 2018

Figure 1.9 is a comparison of Malaysia's research productivity and outcomes against selected advanced economies; it appears that the nation's research productivity has been regressing from 1996 to 2016, despite producing greater publications by 2016. Many countries that experienced similar downward trend in the same period had shown rebound by 2016 are countries that are largely tech-driven with the largest number of researchers in the business sector.

In 1996, Malaysia had an enormous amount of research funding but insufficient number of appropriately qualified research personnel to make the most of the investment as evidenced by the poor research outputs. During this time period, the Government intensified investments in establishing and upgrading the RDCI infrastructure in public universities and research institutes.

In the next 10 years, the number of Malaysian researchers quadrupled which ramped up the number of publications in the country. The majority of the researchers were based in universities and government-linked research institutes where publications are considered a priority. In addition, most of the research funds were channelled towards basic and applied research, with little set aside for experimental projects or industrial scale-ups. The disconnect with the industry also means less focus on patentable or experimental discoveries for expanding economic growth. By 2016, the average GERD per researcher has shrunk, suggesting that the country has become more efficient in generating publications and patents. However, the quantum increase in publications is not accompanied by more granted patents due to mismatched priorities between the researchers and the national STI aspirations.

In short, Malaysia's relatively poor performance can be attributed to the fragmentation of the STI ecosystem with too many researchers in universities whose basic and applied science output have very little traction with industry as well as the lack of long-term R&D investment strategy across all stakeholders.

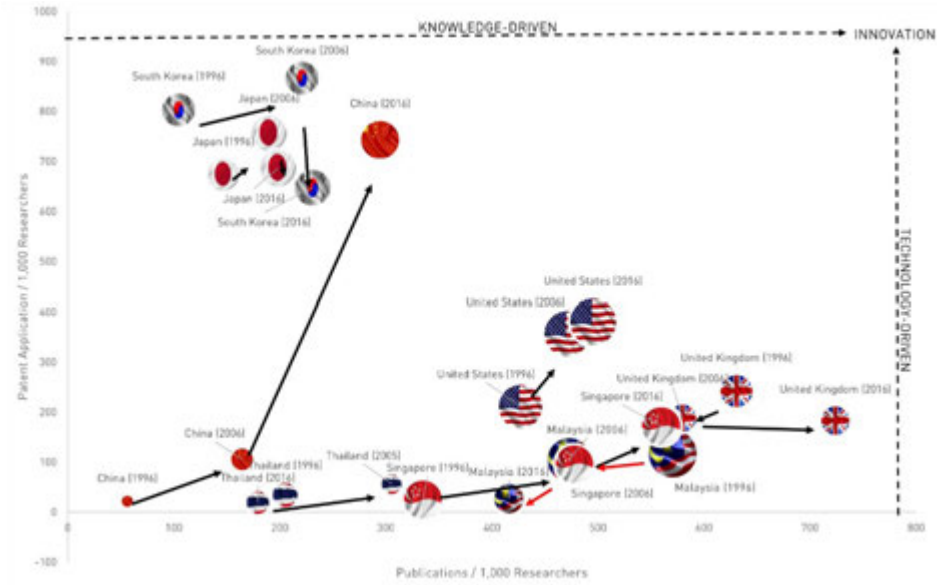


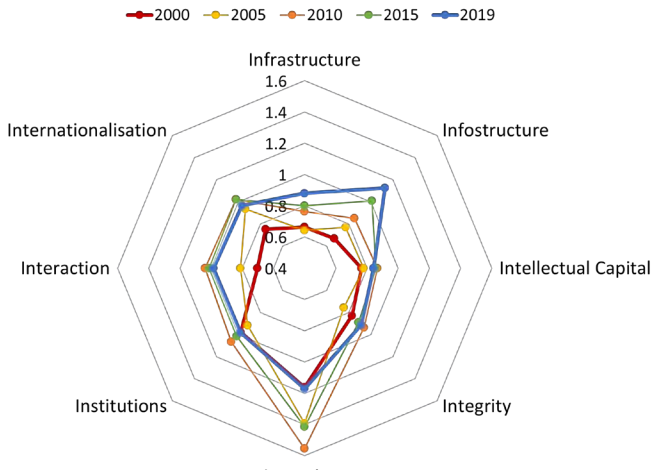
Figure 1.9: Correlation Between Publications, Patent Applications and Average GERD per Researcher (FTE) for 1996, 2006 and 2016

The country's STI ecosystem showed that except for infrastructure and infostructure, the other STI enablers have advanced very little or declined over the years (Figure 1.10). The incentives indicator showed a significant decline, leading to relatively lower industry investment in R&D and other STI-related activities. Reduction in internationalisation suggests that STI activities and networks in Malaysia are not being effectively utilised to penetrate global markets. The gradual weakening of institutions reflect that they are not keeping pace with the rapidly transforming global STI landscape. This indirectly affects the effectiveness of the integrity systems (regulatory architecture and incentive system) in ensuring a dynamic and strong STI ecosystem.

Figure 1.11 illustrates the overall STI indicators and their impact on the economic progress, societal development and environmental sustainability of Malaysia. After a successful transition of the Malaysian economy from an agrarian to an industrial economy, Malaysia's STI ecosystem remained stagnant from 2010 to 2019, and only the economic impact experienced significant growth over this period.

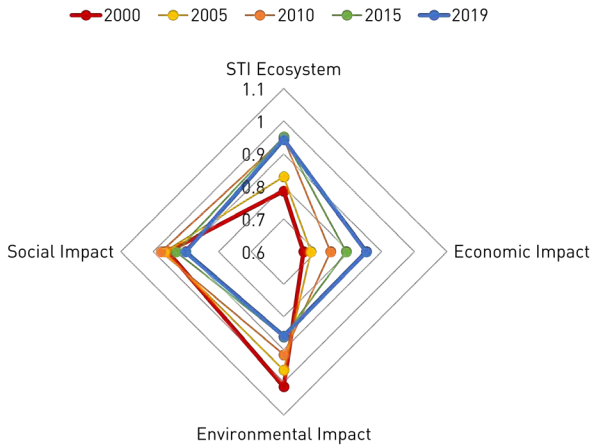
Social development and environmental sustainability declined over the years, with the environment suffering the most, indicating a lack of synchronicity between economic progress and these aspects of the country's growth.

Traditional developmental models enabled socio-economic progress at the expense of natural environmental resources. As Malaysia progresses towards a developed nation status, it must ensure that the nation's prosperity is built upon environmental considerations that are coupled with social equity and inclusion so that no one is left behind.



Analysed by Sunway University Research Team

Figure 1.10Malaysia's STI Ecosystem (using the 8i's model)



Analysed by Sunway University Research Team

Figure 1.11: Malaysia's STI Ecosystem and Its Economic, Societal and Environmental Impact

STI Governance in Malaysia

Numerous government institutions involved in the ideation, planning and implementation of STI-related policies and activities make up a large part of the STI ecosystem in Malaysia. Ministries and agencies carry out varying divergent policies, strategies, and frameworks which led to the fragmentation and inefficiencies in the use of resources. The ecosystem also suffers from duplication of efforts as many players share similar responsibilities, resulting in redundancies and lack of meaningful impact. This has been elucidated at length in the SO2015 and SO2017 reports.

Figure 1.12 illustrates the fluid nature of the highest authority that determines STI policies from 1973 to the present day. Without a central organising entity to coordinate the STI ecosystem effectively across all stakeholders, the economic priorities outlined in the various national development plans (Figure 1.13) failed to align with the RDC&I efforts. This led to wasted resources, duplicity of efforts, and diminished the potential impact of the various national development blueprints.

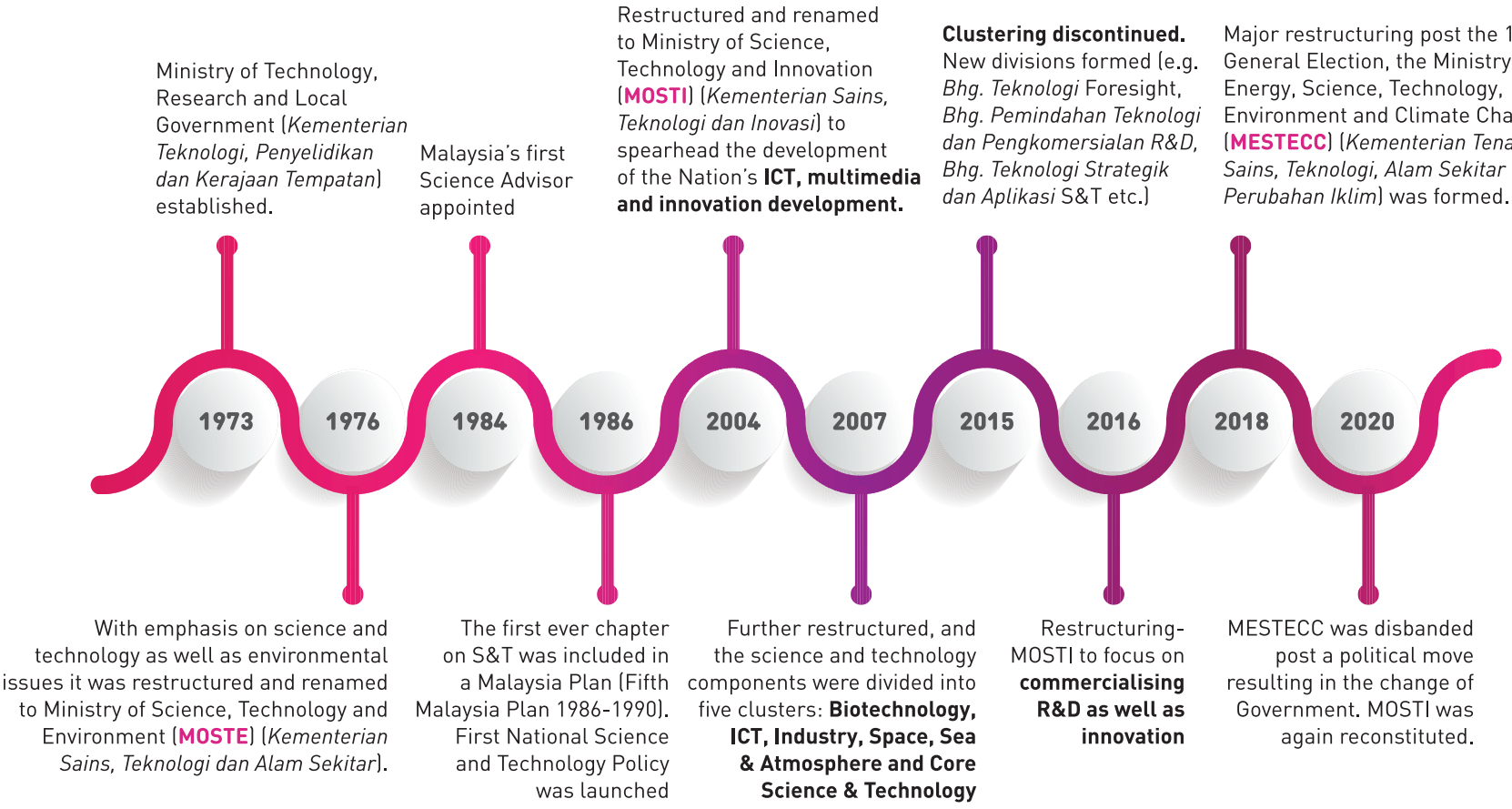


Figure 1.12: The Evolution of the Ministry with the STI portfolio in Malaysia

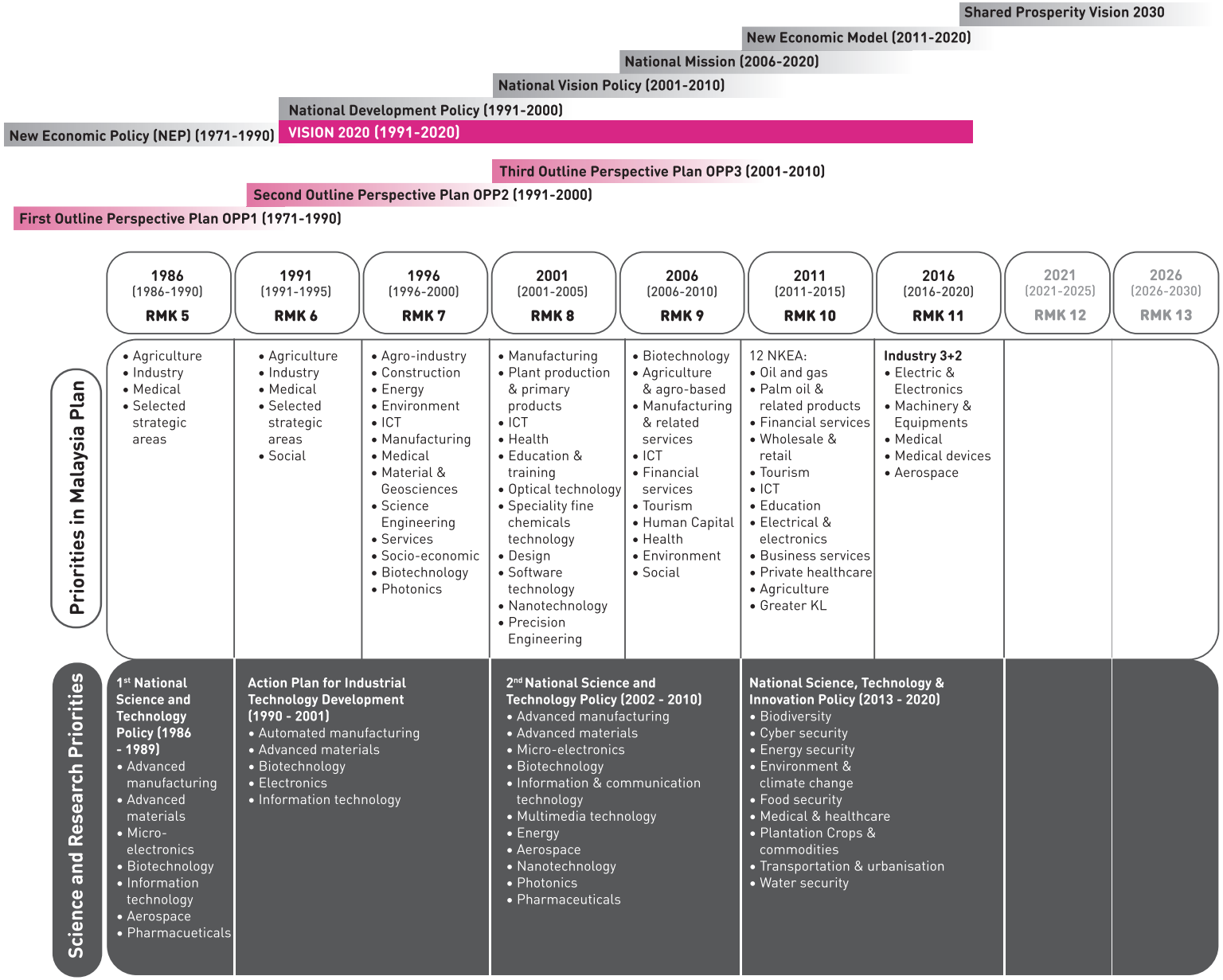


Figure 1.13: Priority Areas of the Various National Development Blueprints

Recognition of the value of STI priorities in planning for state development has led to an increasing number of STI-related portfolios in State Governments with nine states in the Peninsula now with STI-related Excos (Figure 1.14). Sabah has a dedicated ministry on STI which is the Ministry of Science, Technology and Innovation while Sarawak has a Ministry of Education, Science, and Technological Research.

Coordination between federal and state authorities on STI matters is vital for Malaysia's STI ecosystem. The bulk of the resources lie with the federal agencies and ministries while on the ground STI-related activities are carried out by the state governments; hence, harmonisation of STI-policies by these major players would nurture the integration of business entities and other stakeholders in the STI ecosystem more effectively. At the moment, this lack of coherence in STI governance is a stumbling block in cultivating the STI ecosystem needed for successful knowledge economy to propel Malaysia to be an advanced economy by 2030.

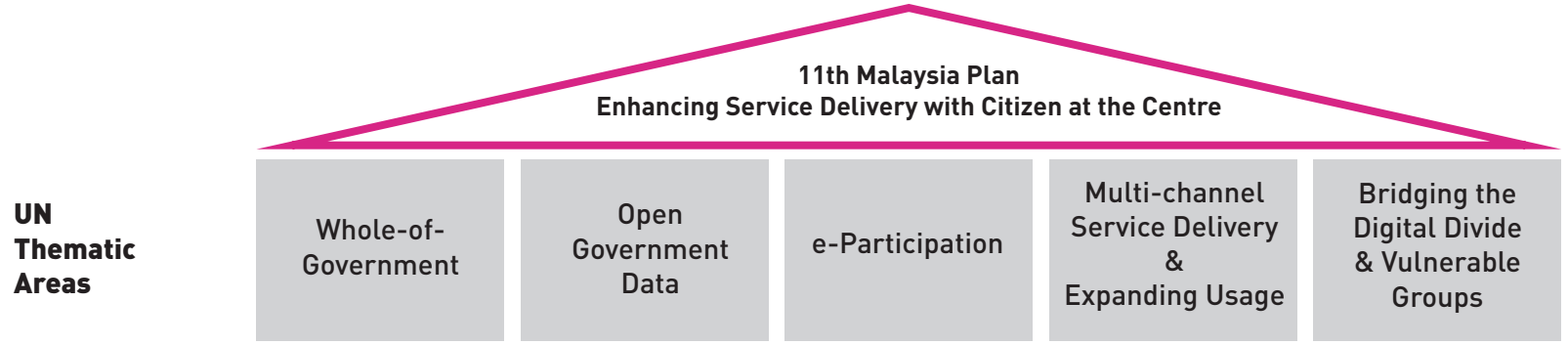
As per SO2017	As of June 2021
Perlis Natural Resources and Environment; Science, Technology and Innovation; Information and Communication Technology Development (ICT), Corporate Communications Affairs & Public Complains; Special Duties	Education, Talent, Higher Education, Science, Technology and Innovation, Information and Communication Technology
Kedah Science, Innovation and Information Technology; Communication and High-Technology; Human Resources	Industry & Investment, **Science, Technology and Innovation**, Higher Education
Kelantan Agriculture, Biotechnology and Green Technology	Human Development, Education, Higher Education, **Science, Technology and Innovation**.
Penang State Economic Planning, Education & Human Resources, Science, Technology and Innovation	Human Capital Development, Education, **Science & Technology**
Perak Education; Science, Environment and Green Technology	Health, **Science**, Environment and Green Technology
Terengganu Exco Pendidikan, Sains, Teknologi dan Transformasi Kerajaan Negeri	No specific STI-related portfolio i)Tourism, Culture and **Digital Technology** ii) Infrastructure, Public Utilities and **Green Technology**
Pahang Health, Human Resources and State-related Special Tasks	**Science, Technology and Innovation**, Communication and Multimedia
Selangor Education; Human Capital Development; Science,Technology and Innovation	Enculturation of **Innovation** & Smart Selangor
Negeri Sembilan Education and Health	No specific STI-related portfolio
Melaka Education; Higher Education; Science and Technology; Green Technology and Innovation	Education, Higher Education, Technical & Vocational, and **Science and Innovation**
Johor Health and Environment; Education and Information	No specific STI-related portfolio
Sarawak Ministry of Education, Science and Technological Research	Ministry of Education, **Science and Technological Research**
Sabah Ministry of Resource Development and Information Technology Advancement * Science Advisor to Chief Minister of Sabah	Ministry of **Science, Technology and Innovation**

Figure 1.14: Expansion of STI Portfolios in State Governments

Is Malaysia on Track for Digital Transformation?

The speed at which knowledge is generated underscores the need to embrace knowledge and accelerate digital empowerment in order not to be left behind. This insight was the core of 9th Malaysia Plan (2006-2010) which highlighted knowledge intensive sectors, including information and communication technology (ICT), and biotechnology as new sources of wealth for the nation.

A digital-ready government is crucial to nurture knowledge economy, which is why the mid-term review of the 11th Malaysia Plan (2016-2020) had identified the various components needed to build a digital government operative model to better serve the people of Malaysia (Figure 1.15).



Reference: MAMPU (2017)

Figure 1.15: Malaysia's Digital Government Roadmap under the 11th Malaysia Plan

A digitally enabled government will provide integrated end-to-end online government services which are more efficient, effective and transparent. Malaysia in 2025 will advance to achieve the following targets for the *Rakyat*, businesses and the Government (EPU, 2021):

RAKYAT	BUSINESS	GOVERNMENT
• Creation of 500,000 new jobs	• 30% uplift in productivity across all sectors by 2030	• 100% civil servants to possess digital literacy
• 100% households with access to internet	• 22.6% of digital economy to Malaysia's GDP	• 80% end-to-end online government services
• All students to have access to online learning	• 875,000 micro, small and medium enterprises (MSMEs) adopt eCommerce	• All ministries and agencies to provide cashless payment option in 2022
	• Attract 2 unicorns (home-grown or foreign)	• 80% usage of cloud storage across the government in 2022
	• RM70 billion investment in digitalisation	
	• Increase the number of start-ups to 5,000	

The country's performance in the E-government ranking has dropped 15 places from number 32 in 2010 to number 47 in 2020 (United Nations, 2021). Nonetheless, Malaysia is on track for the six dimensions of digital government framework outlined by the OECD, making significant progress in moving from an information-centred government to a data-driven public sector as well as proactive policy making and service delivery (OECD, 2018a).

Malaysia began mapping the national digital governance beginning with the inception of the Multimedia Super Corridor (MSC) in 1996. The desired end-state of the original MSC was to achieve exponential growth through state-of-the-art infrastructure in the Cyberjaya and MSC areas to attract world-class companies to collaborate with domestic companies to spur regional, if not global, champions that will take endogenous technology to the next level. However, none of the seven MSC flagship projects launched fully realised their potential due to fragmentation in the STI ecosystem (Figure 1.16).

MULTIMEDIA SUPER CORRIDOR

The Seven Flagships (1996)

1 ELECTRONIC GOVERNMENT — PARTIALLY ACHIEVED

Lead agency: **The Malaysian Administrative Modernisation and Management Planning Unit (MAMPU)**

To introduce multimedia technologies towards a **paperless administration**. Aim is to have a paperless Prime Minister's office by 2000. Eventually, most inter-departmental communications and interactions with the public will be conducted via electronic and multimedia channels, including card-based birth and marriage registration, and drivers licences.

Selected Ministries and departments will also be equipped with multimedia mobile offices, video-conferencing, digital archiving, shared databases, and digital signature facilities.

2 SMART SCHOOLS — NOT ACHIEVED

Lead agency: **Ministry of Education**

To ensure that **all of its schools have internet access within two years** as a way to rapidly enhance information technology (IT) literacy.

3 TELEMEDICINE — PARTIALLY ACHIEVED

Lead agency: **Ministry of Health**

The key elements of telemedicine planned include distance learning; remote consultation, diagnosis, and treatment; virtual patient records; and a national , **electronic medical network.**

The Selayang Hospital is the pilot hospital-uses Electronic Medical Records. MOH has requested for budget to test out at Hospital Seremban.

An R&D cluster of universities and companies focused on developing new applications to position Malaysia as a **centre of excellence in telemedicine has not materialised.**

4 R&D CLUSTER — PARTIALLY ACHIEVED

Lead agency: **Ministry of Science, Technology and Environment**

To be at the forefront of R&D next-generation multimedia technologies by developing **collaborative R&D centres between corporations and universities.** Multimedia University, to be the **catalyst in creating a research community** which will utilise MSC's unique environment to test new multimedia and IT applications.

5 NATIONAL MULTI-PURPOSE CARD — PARTIALLY ACHIEVED

Lead agency: **Bank Negara**

The MSC will be the testbed for a whole-first, **national multi-purpose card** that will be issued to all Malaysian citizens.

This smart card can serve as a national identity card, and "electronic purse" **a credit card, telephone card, club membership card, and will ultimately be used in all electronic transaction with the Government.**

6 BORDERLESS MARKETING CENTRE — PARTIALLY ACHIEVED / LOW VALUE-ADDED

Lead agency: **Multimedia Development Corporation (MDC, now Malaysia Digital Economy Corporation, MDEC)**

To **serve as an excellent platform for companies' customer service operations, such as telemarketing, technical support, "backroom" data processing, and local customisation of marketing materials.**

7 WORLDWIDE MANUFACTURING WEB — PARTIALLY ACHIEVED / LOW VALUE-ADDED

Lead agency: **Ministry of International Trade and Industry**

Companies to use the MSC to establish **regional hubs** for real-time control, monitoring, and delivery of operational support to their regional networks of design, manufacturing and distribution centres.

Using the MSC's low-cost, high-performance information and logistics networks, regional operations can be linked with operations across the globe 24 hours a day, 365 days a year.

Figure 1.16: Progression of the Seven Flagships of the MSC

The Global Connectivity Index (GCI) annually ranks 79 nations according to ICT investment, ICT maturity, and digital economic performance. Malaysia dropped by one spot between 2015 to 2020 while many other ASEAN countries have been improving.

As reflected in the fixed broadband average download in Figure 1.17, Malaysia must keep pace with advanced economies in ICT infrastructure to support its digital and knowledge economy aspirations.

Digital access in Malaysia has improved between 2013 to 2019, with the urban-rural gap narrowing significantly from 2017 onwards (Figure 1.18). The stability of the connection heavily favours the urban population, whilst the rural population has pockets with low to zero connectivity. This gap was magnified during the pandemic when all schooling was done online and a significant proportion of the workforce having to work from home. It is also a reflection of the income disparity with the more economically precarious household lacking not just connectivity but also the digital devices.

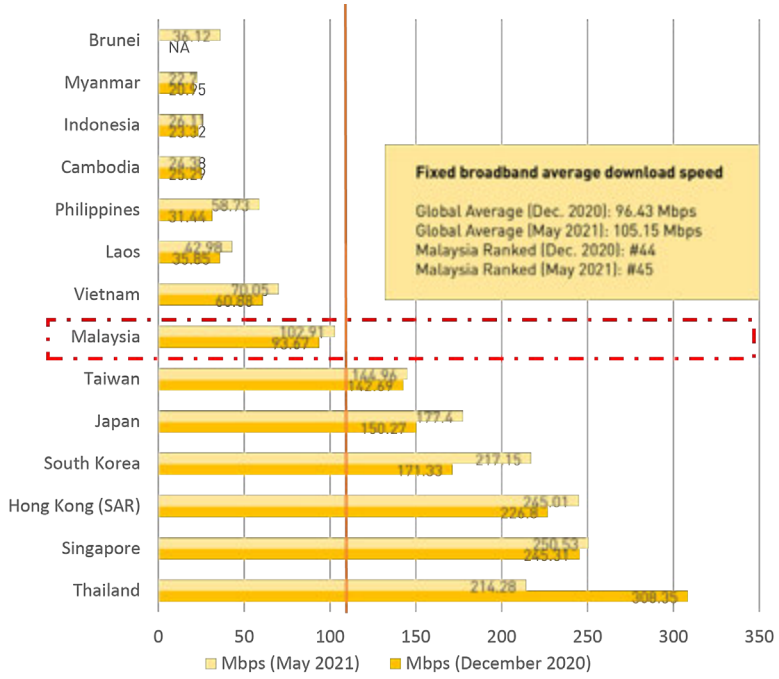


Figure 1.17: Fixed Broadband Average Download Speed of ASEAN and Selected Countries

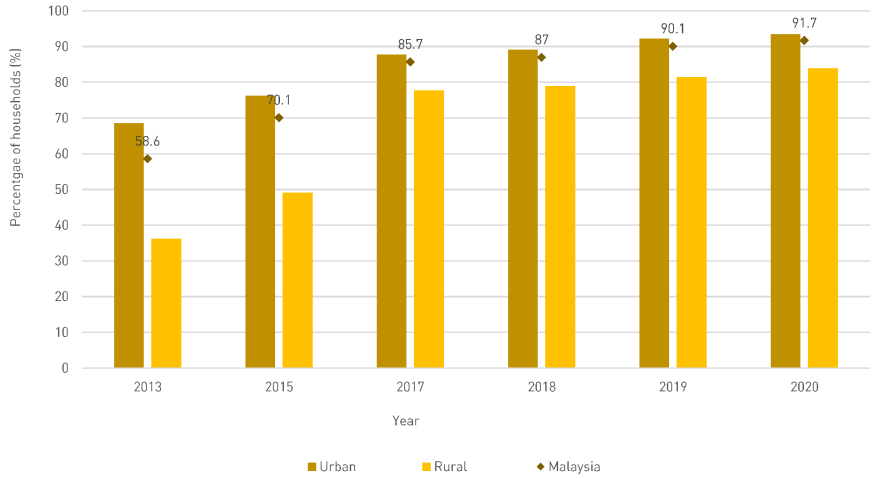


Figure 1.18: Percentage of Household Internet Access

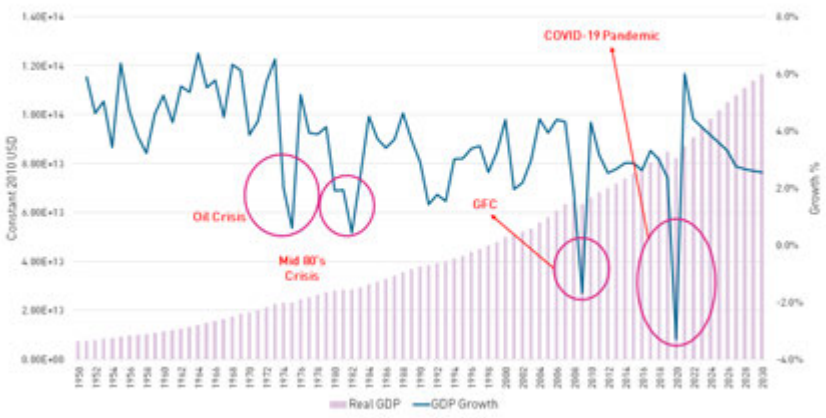
Building Resilience and Competitiveness

Malaysia, being part of the global economy, is susceptible to technological and financial shockwaves that strike the interconnected global economy. Historical and contemporary examples show the importance of cultivating a robust STI ecosystem with the dynamism to respond to these changes quickly and effectively. Beyond tech, globalisation means greater mobility of people, data, goods and services, and increase in trade across the globe. Such resilience can only arise from agile policies, plans and initiatives that support better growth trajectory.

As seen in Figure 1.19, the world economy has been growing steadily in the past 70 years. The volatility in global markets demonstrate that the impacts are no longer limited by the borders of a nation or a region; instead, the repercussions can be felt across the globe. Countries with lower economic resources tend to suffer more from these upheavals and take longer to recover from the damages to their economy. Moments of crises can open opportunities for countries that are prepared to explore and leverage different possibilities to ensure sustainable development, e.g., South Korea's economic progress after the Asian financial crisis in the late 1990s.

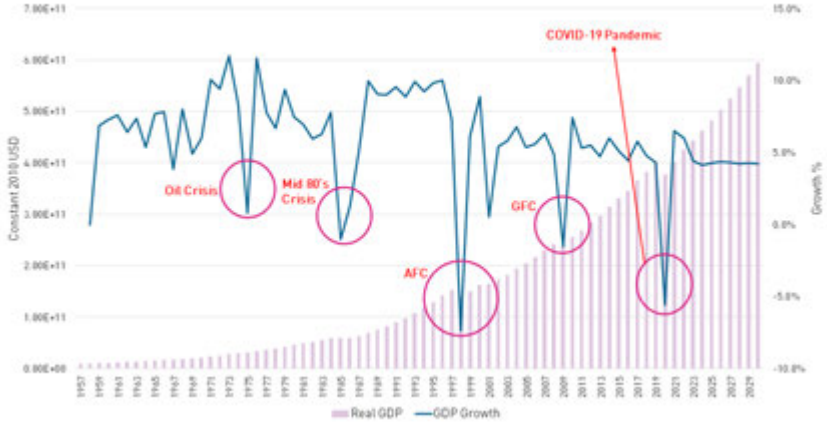
More recently, no continent has been spared of the COVID-19 pandemic which adversely impacted the global economic system, leading to contraction in growth across every region and countries. However, countries with more robust STI ecosystem were able to deal with the pandemic more effectively than countries with weak STI ecosystems.

Comparing Figure 1.20 with Figure 1.19, it is evident that Malaysia's economic growth patterns are similar to the rest of the world. This suggests that the Malaysian economy is inter-connected to the global markets.



Analysed by Sunway University Research Team

Figure 1.19: Trend in World's Real GDP against Economic Growth (1950 – 2030)

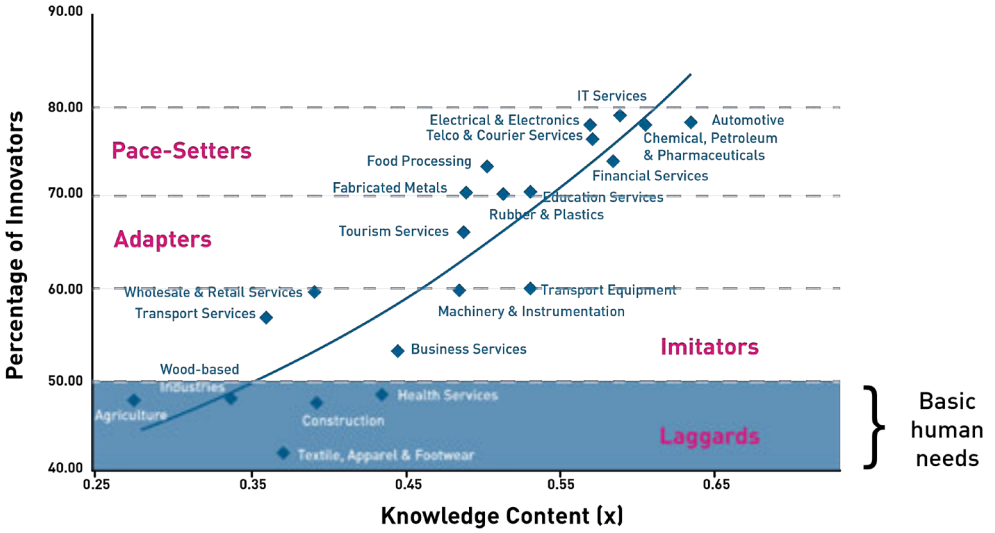


Analysed by Sunway University Research Team

Figure 1.20: Malaysia's GDP and Economic Growth (1957 – 2029)

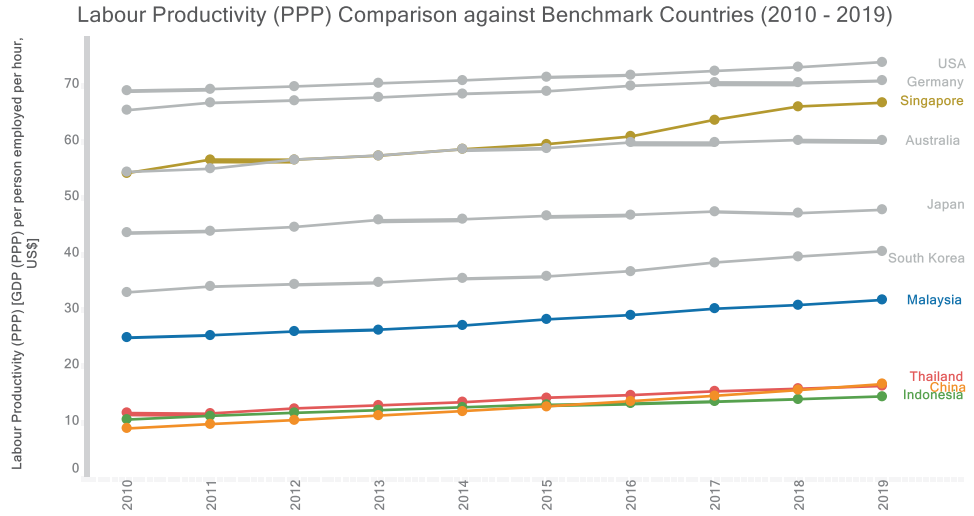
Figure 1.21 shows the state of Malaysia's industries based on knowledge content. Malaysia is a pace setter in certain industries such as IT services, electrical and electronic goods and petrochemicals.This shows that there are sectors where the STI ecosystem performs well. Unfortunately, the greater number of the nation's industries are adapters and imitators operating at a lower end of the global value chain. It is worrying how sectors related to basic human needs such as health services, construction, agriculture, and apparel remain laggards with little knowledge generation or innovation.

Looking at the overall productivity growth (Figure 1.22), Malaysia continues to lag advanced countries. The nation's inability to close the gap with other developed countries is a matter of concern, especially in upgrading their STI ecosystem. Most of Malaysian industries depend on low-skilled foreign workers and are content to remain as adapters or imitators in their sector. There is a need to transform the industry ecosystems to be more technology and innovation driven.



Reference: Adapted from EPU (2016)

Figure 1.21: Innovation-led Knowledge Content in Malaysia

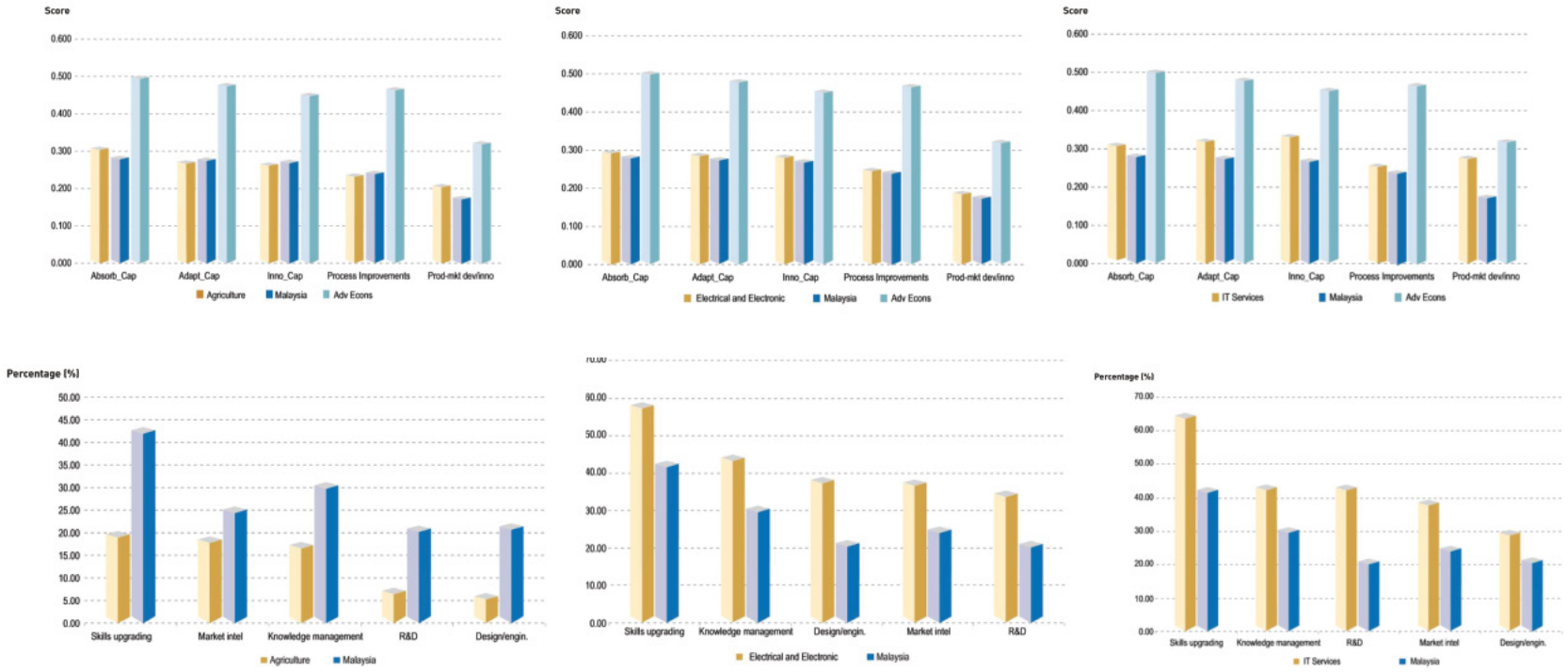


Analysed by Sunway University Research Team

Figure 1.22: Malaysia's Productivity Against Benchmark Countries (2010 – 2019)

Figure 1.23 shows how Malaysia has yet to catch up with advanced economies in terms of dynamic capability and knowledge intensive activities across three sectors. The agriculture industry is an example of the sector's inability to increase dynamic capabilities and knowledge intensity. Although the country did better in the electrical and electronics (E&E) as well as the information technology (IT) sector, more effort is needed to strengthen the STI ecosystem for these sectors in order for Malaysia to achieve the desired prosperity and sustainable growth outlined in SPV 2030.

There are three major gaps that led to the lack in dynamic capability and knowledge intensive activities across these industries, the first of which is the talent and skill gap. The agriculture industry is perceived as unattractive in terms of salary, career prospects, and societal perception of farming. In the E&E and IT sector, the skills gap arises from dynamic shifts taking place in the sector and the inability of the education and training institutions to keep pace with the changing needs of these industries as they transform.



Reference: EPU (2016a)

Figure 1.23: Dynamic Capability and Knowledge Intensive Activities of Three Key Sectors

The second gap is the competitiveness gap. Malaysian agriculture industry has been falling behind due to continued entrenchment of commodity products through traditional farming while the global agricultural industry has moved forward with strong levels of automation, adoption of emerging agricultural science, and digitalisation of farming to connect with global food supply chains. This is an example of competitiveness gap (or industry capability gap), which also affects the E&E and IT industries. The E&E sector has performed well in the low-value add back-end part of the E&E industry and has built the skills, capacity and capability in the back-end "packaging" part of the E&E over time. However, in the high-value front-end IT fabrication and design and development, the E&E sector are finding it difficult to stay competitive due to the level of investment needed and scale of operations needed due to the lack of technical skills and specialist scientific knowledge. The mismatch in the IT sector is a consequence of the rapidly evolving STI landscape that defines the IT industry's digital and emerging artificial intelligence (AI) evolution.

The third gap relates to market development and market positioning of local industries. For instance, the agriculture and ICT services industries are heavily dependent on the domestic market. Considering the small size of the domestic market, it is imperative for Malaysian firms to have robust access to and operate in international markets to avail themselves of the economies of scale and scope needed to build their competitive advantage. Despite strong progress, Malaysian industries have been unable to build strong global competitive advantage positions across the full spectrum of their industry operations; whatever global competitiveness has been attained to date happened in narrow niches.

The Government has made several attempts to catalyse industry using STI to spur growth. For instance, the Government's investment in biotechnology as an engine for growth through the BioValley in 2003, followed by Biotech Corporation in 2005 as well as the National Biotechnology Institutes to administer the implementation of the National Biotechnology Policy (Figure 1.24). Unfortunately, this initiative has been unable to achieve its full potential to contribute to the broader economy as compared to other countries that embarked on similar biotechnology initiatives. One of the problems was the lack of focus on niche areas where Malaysia has competitive and comparative advantage, and secondly the investments were thinly spread across many initiatives.

The evidence points to a national STI ecosystem which is more suited for a production-based economy rather than a knowledge-based economy. The challenges faced by the biotechnology sector in Malaysia (Figure 1.25) are also seen across other STI-related industries.

Malaysia has been losing its competitive edge to regional economies with relatively cheaper labour and larger markets. To move up the value chain, Malaysia needs to invest in its STI ecosystem to enhance dynamic capabilitiesand total productivity. As part of this plan, investments should be intensified to nurture homegrown technologies that spur innovation and transform Malaysia into a competitive knowledge-based economy.

2010

- 350 biotechnology companies
- 207 BioNexus companies 2,824 FTEs, Direct human capital: 13,690 direct skilled and unskilled jobs (2010)
- BioNexus Revenue: RM0.7 billion (2011)
- Allocation of Biotech-related Projects to MOSTI (2011-2015): **RM91.6 million**

2020

- BioNexus Revenue: RM1.52 billion (2019) 250 biotechnology companies
- Number of patent in biotechnology: 128 (2018)
- Global share of biotech scientific publications: 2.38% or 3,233 papers (2019)
- Allocation of Biotech-related Projects to MOSTI (2016-2020): **RM20 million**

Policy Documents / National Initiatives

National Biotechnology Policy Phase 1: Capacity Building (2005)

Protection of New Plant Varieties Act (2004)

National Biotechnology Policy Phase 2: Science to Business (2011)

Enhancement to IP Policy and Management Framework (2015)

National Biotechnology Policy Phase 3: Global Business (2016)

Malaysia Bioeconomy Corp moved to MAFI (2018)

National Policy on Biological Diversity (1998)

National Biofuel Policy (2006)

National Policy Biological Diversity (2016)

1995 — 2000 — 2005 — 2011 — 2012 — 2015 — 2018

Organisation

Malaysian Biotechnology Information Centre (2000)

National Biotechnology Directorate (NBD) (1995)

BiotechCorp (2005)

NBD to BIOTEK, MOSTI (2005)

National Biotechnology Institute now National Institute of Biotechnology Malaysia (2011)

3 National Biotechnology Institutes (2005):
- ABI
- IPHARM
- MGI

Disbandment of BIOTEK, MOSTI (2015)

BiotechCorp rebranded to Malaysia Bioeconomy Corp (2016)

278 BioNexus companies were established (2016)

The Forum on Harmful Tax Practices (FHTP) was used to determine Bionexus status (2018)

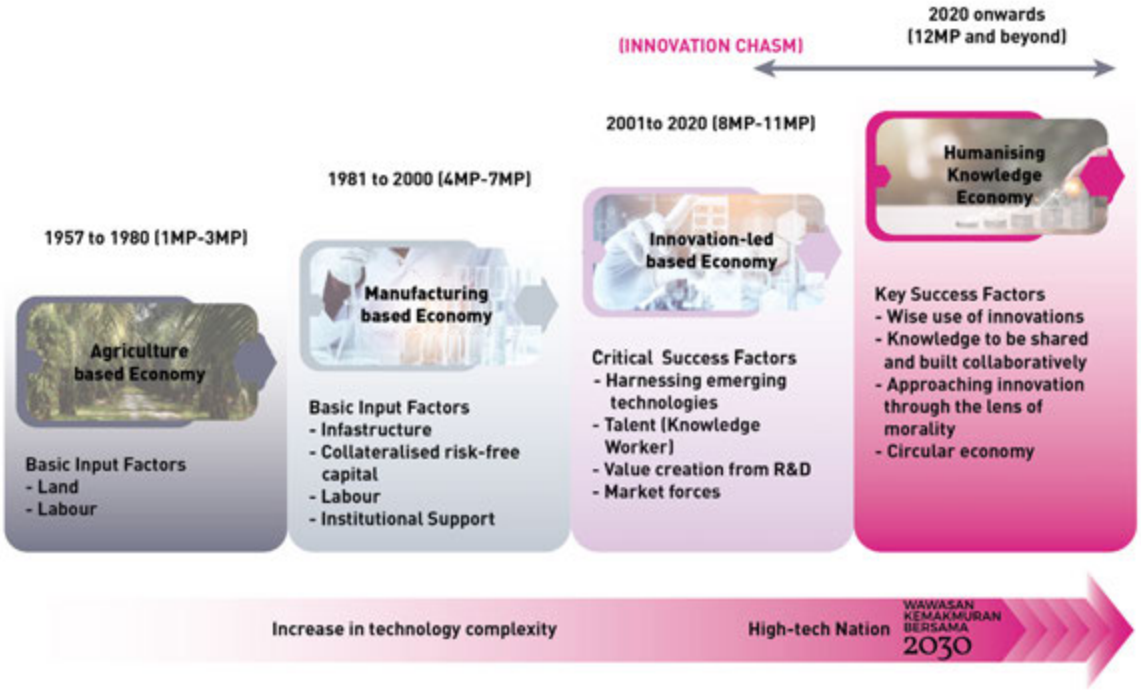
Figure 1.24: Biotechnology as an Industry in Malaysia

Humanising Growth for Sustainable Progress

History has shown that human progress is often built on knowledge creation and its application. This process has been accelerated over the past three centuries, culminating in the birth of information and communication technology (ICT) which has transformed every facet of human life. Increasing knowledge diffusion has a positive impact on socioeconomic development of societiesacross the globe, intensifying the pace of globalisation through the formation of global knowledge networks and supply chains. This has led to greater homogeneity in the economic and social systems across the globe.

The increasing convergence in STI elements has led to convergence in economic, social and environment and other global systems which poses challenges to many countries. Advanced countries with stronger STI ecosystems are in a better position to benefit from this convergence and set the tone for global developmental agenda. Countries that lag in the STI development are becoming increasing dependent on countries that are leading the agenda.

The national developmental policies were designed with adaptations for the evolving international economy and increasing technological complexity that spurs globalisation (Figure 1.25). Analyses of major development policies that emphasised on tangible economic gains demonstrated that such measures are not only unsustainable, but also adversely affect societal and environmental well-being which underscores the need for national policies to be people-centric rather than GDP-oriented alone.



Reference: Adapted from ASM, (2017)

Figure 1.25: The Changing Global Economy and Malaysia

Humanising the knowledge economy is an attempt to reduce support for unfeasible economic activities through STI to balance socio-economic development and socio-environment sustainability. This requires talent capable of dealing with the knowledge paradigm catalysing globalisation (Figure 1.26) to strengthen Malaysia's resilience and capacity against cataclysms – such as the COVID-19 pandemic and world market instability – that threaten the nation's progress.

Figure 1.26: Knowledge Paradigms for the 21st Century Economy

Malaysia's education system has made tremendous progress in laying the foundation for the country's talent, based on the overall literacy rate improvement from 82.9% in 1991 to 94.9% in 2018 (World Bank, 2021). Most of the population attained at least secondary school qualification (Figure 1.27). Unlike many other countries, there are more women obtaining tertiary education than men in Malaysia, indicating fewer gender-based barriers for young girls and women in education. Unfortunately, women still face barriers in the workplace with many of these qualified talents leaving the workforce to raise their families. This is a significant loss to the productive capacity of the economy during prime reproductive age to raise
their family.

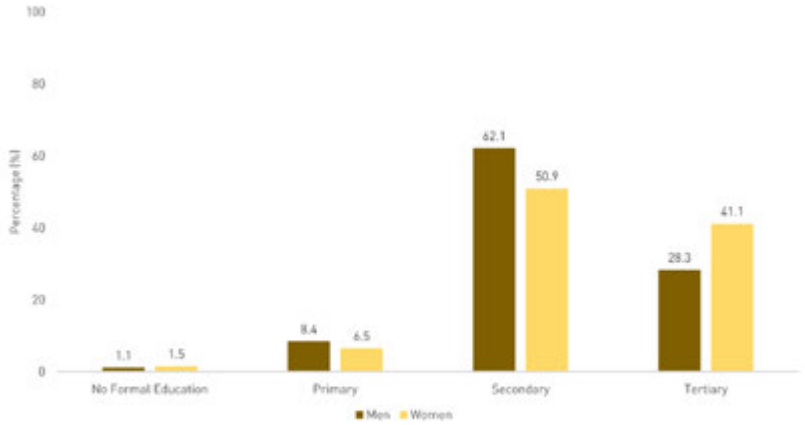


Figure 1.27: Employed Malaysian by Educational Attainment based on Gender, 2019

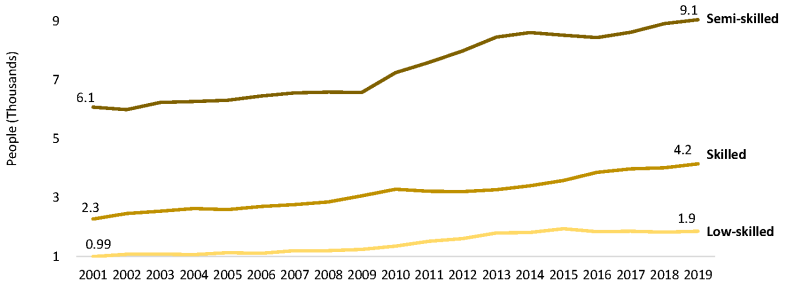


Figure 1.28: Employed Person by Occupation Sector (2001-2019)

Most of the nation's employment is in the semi-skilled category (Figure 1.29), suggesting that Malaysian industries are engaged in the mid to low end of the global value chain. This is impairing Malaysia's competitiveness and resulting in nation being caught in the middle-income trap.

Comparison of Malaysia's talent growth per the Global Innovation Index Report in 2016 and 2020 indicated that the nation is performing poorly in knowledge workers preparedness despite improvement in tertiary education attainment and knowledge absorption (Figure 1.29). This is also another indicator that the industry's capacity for innovating up the value chain is below par.

Malaysia is lagging behind other developed countries in translating knowledge into innovation and wealth due to the Malaysian industry's dependence on low-skilled foreign labour, mismatch in skill sets as well as education attainment levels. Most Malaysian firms have strong absorptive capabilities but lag advanced countries in adaptive and innovative capabilities (Figure 1.30). Inculcating an STI ecosystem that helps the industry to expand their dynamic capabilities, in particular building strong adaptive and innovative capability, including nurturing a knowledge sharing and risk-taking entrepreneurial culture are crucial aspects for Malaysia to become a developed high-income nation.

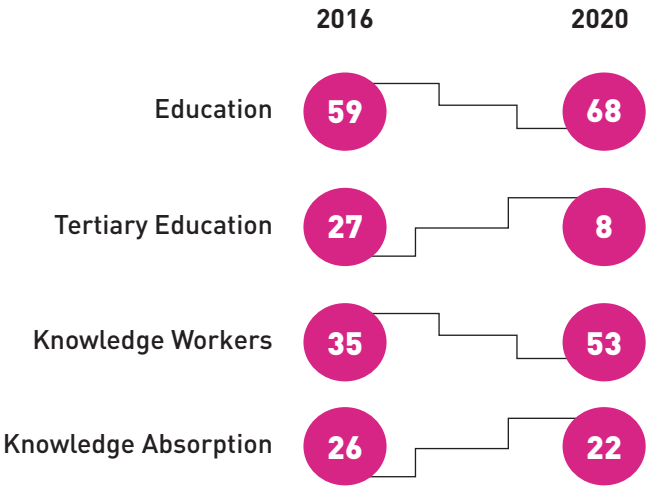
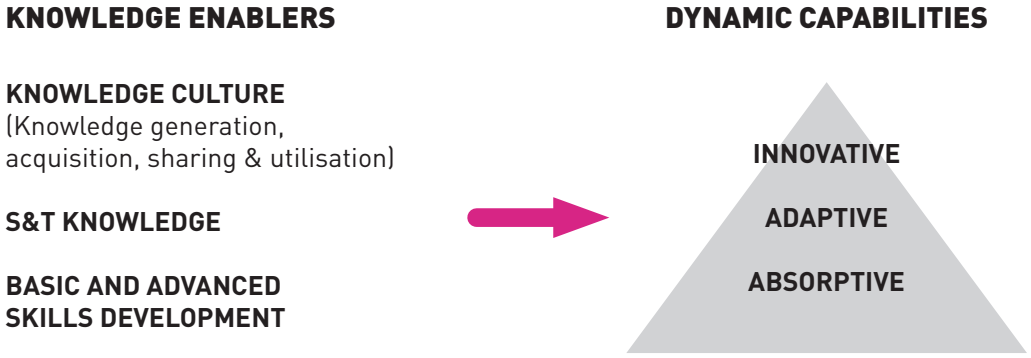


Figure 1.29: Malaysia's Talent Capital Progress in the Global Innovation Index Report



Reference: Adapted from EPU, (2016)

Figure 1.30: Dynamic Capabilities of Malaysian Industry

Malaysia has grown into an upper middle-income country with vastly improved human development indicators, attaining Gross National Income (GNI) per capita of USD11,230 in 2019. Malaysia is likely to transition from an upper-middle income economy to a high-income economy in the next few years if Malaysia is able to strengthen its STI ecosystem.

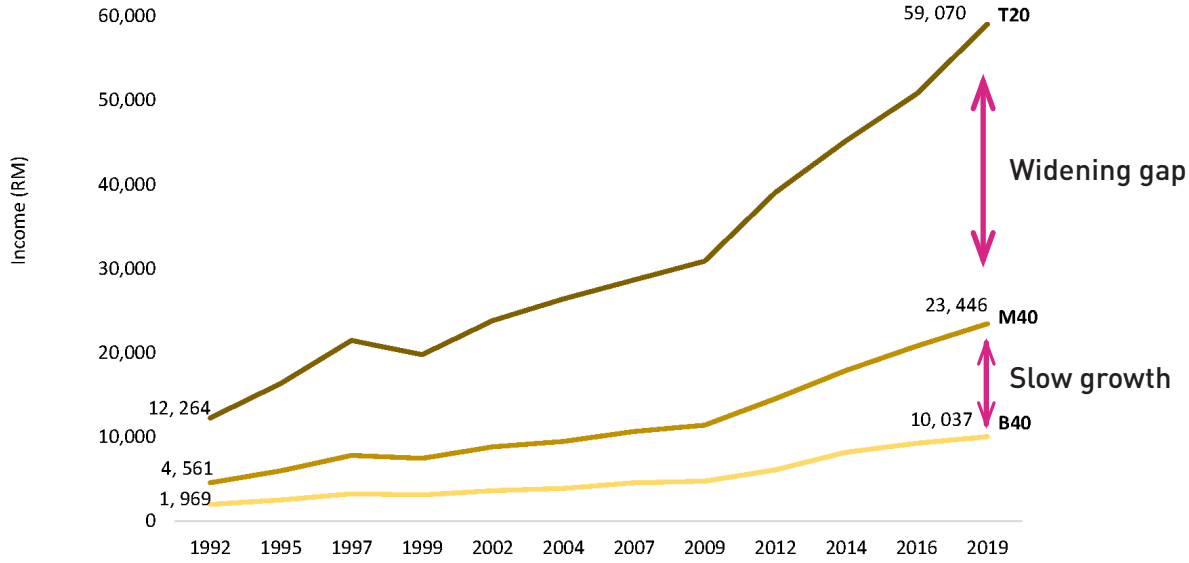


Figure 1.31: Mean Household Income based on Household Group

There have been many national development initiatives to close the income disparities in the country, and some of the initiatives have been successful in addressing the development challenges. However, rapid transformation of the Malaysian economy towards a more knowledge driven economic structure and slowness in many of the enablers of the STI ecosystem has increased the knowledge and income gaps among the different segments of the population in the country (Figure 1.31). The sluggish wage growth affects socio-economic mobility of those from the lower socio-economic tier; about half of Malaysian workers, or 4.4 million people are B40, who earn RM2,160 or less a month (BNM, 2019). The national mean poverty line income for households in Malaysia in 2019 is RM2,208 per month (with RM1,169 for food and RM1,038 for non-food items) (DOSM, 2020). When this was contrasted against the median house prices in Malaysia – which was four times the annual median household income in 2019 – house ownership is becoming out of reach for many sections of the society.

The B40s are plagued with physical and mental health issues, made worse by the pressure of surviving on stagnant wages while the cost of living continues to rise. The urban poor were further burdened during the COVID-19 pandemic with the movement control orders (MCOs) diminishing their precarious income with little to no social safety net.

1 in **2 adults** in Malaysia are overweight or obese (NHMS, 2019).

20.7%
of children under five are stunted

11.5%
suffer from wasting
(UNICEF, 2019a)

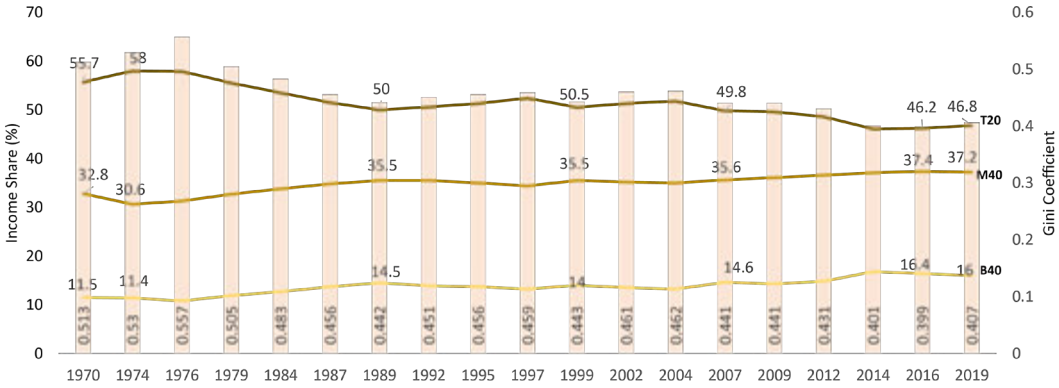
Access to vegetables and fruits among urban poor are decreasing on average. Malaysians' consumption of these food items has not reached the recommended minimum requirement of 200 to 250g per day.

1 in **4 Malaysians** turn to less nutritious food due to poverty.

1 in **5 Malaysian** households could not afford to feed their children a variety of foods (UNICEF, 2018; Ahmad et al., 2020).

The National Health and Morbidity Survey (NHMS) 2019 reported that one in three Malaysians experience mental health problems and roughly half a million adults suffer from depression in the country. Prevalence of mental health issues in Malaysia has tripled from 10.7% in 1996 to 29.2% or 4.2 million people in 2016. However, the stigma afflicting mental health issues as well as insufficient talent capital is making is harder to address this issue; the ratio of psychiatrist to 100,000 population is 1 (10 times less than the recommendation made by WHO of one psychiatrist per 10,000 population) and in 2018, only 15 clinical psychologists were employed in the public health service sector (Chua, 2020). As financial hardship arising from the pandemic drives more Malaysians to seek public healthcare service, the service delivery is expected to be adversely affected as insufficient resources are available in the face of greater demand.

The inequitable wealth distribution over the last few years shows a concerning trend in the country which is reflected in the increase in the Gini coefficient from 0.399 in 2016 to 0.407 in 2019. to (Figure 1.32). Under the mid-term review of the 11th Malaysia Plan, efforts were put forth to raise the B40 households into the middle-class community from 16.8% in 2014 to 20% by 2020. However, the numberof B40 households that transition to M40 declined from 16.4% in 2016 to 16% in 2019. This troubling trend was recently reported by DOSM and Ganeshwaran (2021) that 600,000 M40 households, or at least 8% of Malaysian households, have slipped into the B40 segment of the population due to the pandemic.



Reference: Adapted from DOSM, (2020)

Figure 1.32 : Gini Coefficient of Various Malaysian Households

The Human Capital Index (HCI) – which measures the amount of human capital that a child born today can expect to attain by age 18 – score for Malaysia is 0.611, indicating that the future earnings potential of children born today will be 61% of what they could have been with complete education and full health. This score is expected to be diminished by the impact of the global pandemic on the quality of children's education as well as other socio-economic stressors arising from it.

Malaysia's performance is relatively poor in comparison to advanced economies (Figure 1.33), which suggests the present national education and health policies are weak in building the HCI of Malaysian youths. Both sectors receive among the highest funding from the national budget, which may imply the need to review policy implementation to optimise expenditure and maximise outcome for the children.

The COVID-19 pandemic has given rise to many examples illustrating the unpreparedness of the STI ecosystem to deal with unanticipated shocks to the healthcare system, industrial structures and social well-being of society. The lack of a coordinated approach across multiple agencies and institutions worsened the spread of COVID-19 and prolonged enforcement of the MCOs. This imposed significant burden on the healthcare system and hampered economic recovery.

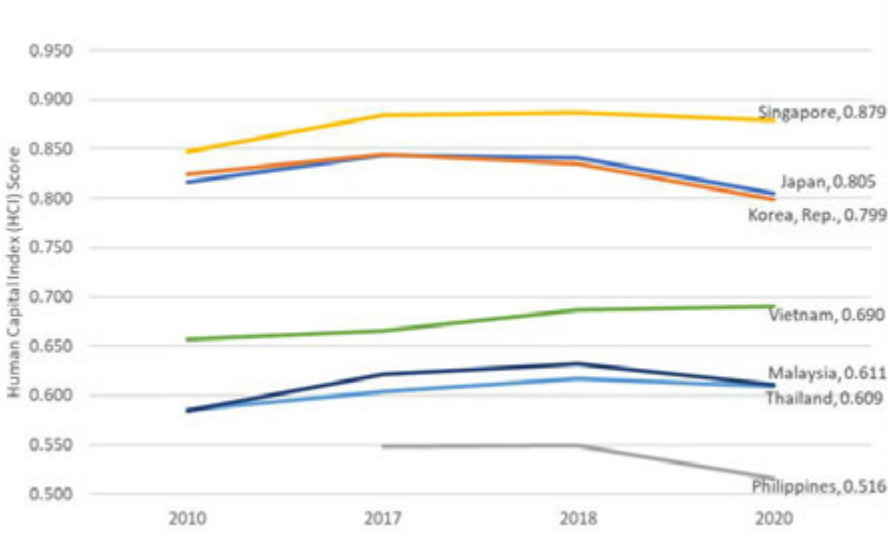


Figure 1.33: Human Capital Index Comparison Against Selected Countries

A vital strategy to ensure economic recovery and strengthenthe healthcare system to address COVID-19 and future pandemics will require the development of a dynamic, agile and responsive STI ecosystem. This would entail developing a comprehensive competency framework aligned to socio-economic sectors of the country. Conducting Foresighting exercise to match Malaysian global STI trends would be invaluable in linking talent with industry, corporate R&D labs, public administration, technology enterprises, spin-off companies, and academia. All these efforts would require periodic evaluation and impact monitoring to ensure optimal resource management for favourable outcomes.

Understanding the cause, effects, and best interventions to fix societal ailments requires long-term investment and planning. This is where a longitudinal study that links different social, economic, and environmental factors driving health outcomes to formulate long-term health policies comes in. Information from these analyses will help shift the healthcare system to preventive care rather than treatment and thereby lower the burden on the national healthcare system.

The study can feed into a comprehensive registry with end-to-end data collection and monitoring of health status through multifaceted policies using the Whole-of-Government (WOG) and Whole-of-Society (WOS) approach. The intersection of this exercise with socioeconomic disparity data can be used to develop cross-cutting measures to reduce inequities suffered by Malaysians to promote upward mobility through social cohesion and economic stability.

Holistic evaluation of the nation's progress is not just about the people and the economy, but also the natural capital of the country. Like many other countries, Malaysia's natural assets have bankrolled the socio-economic growth of the nation, at the expense of the natural resources and environment. Unfortunately, the STI advances that have fuelled the economic progress are not in step with environmental protection and conservation efforts (see Figure 1.11).

The nation's natural assets – from water catchment network, tropical rainforest, peat swamp forest, wetlands, mountains and hills of granite and limestone, to the rivers, lakes, and sea – have diminished as a consequence of supporting Malaysia's economic progress. The number of forested areas slowly declined from 1990 to 2018, particularly the peat swamp forest which halved within that period. The loss of carbon sinks from massive deforestation of tropical peat swamp forest worsens Malaysia's GHG emission, affects the nation's mega-biodiversity as well as impairs Malaysia's climate change adaptation.

Figure 1.34 shows the fluctuation of Malaysia's performance in the Environmental Performance Index (EPI) by the Yale Center for Environmental Law and Policy. The only significant progress was in the climate change index but the country's performance declined across other parameters, scoring below 50 in vital spheres such as pollution emissions, forestry, water, and fisheries. These are red flags that need to be addressed for the country to flourish in a sustainable manner and ensuring that the natural assets are conserved for future generations.

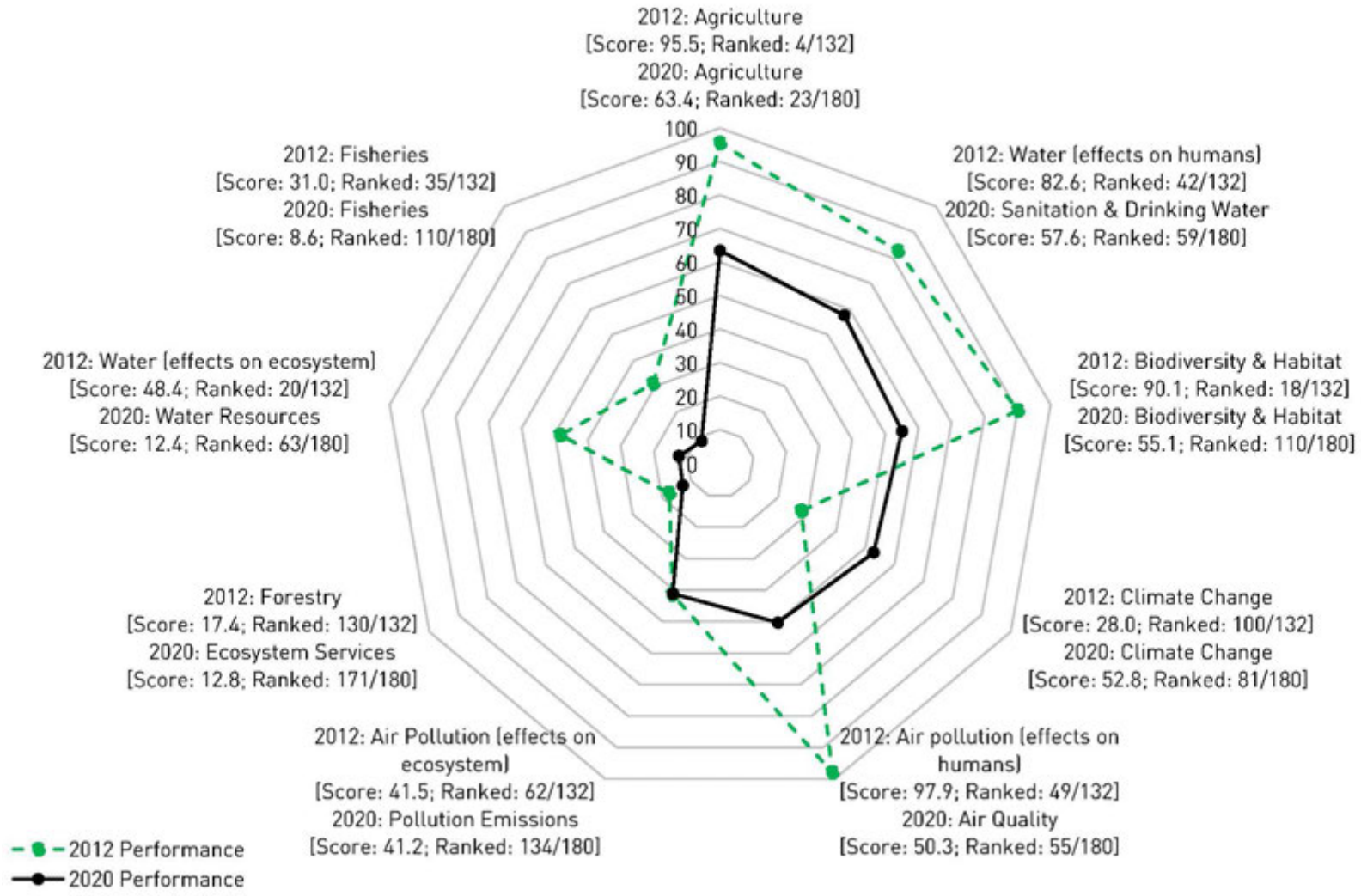


Figure 1.34: Malaysia's Performance in EPI 2012 and 2020

Urbanisation, population expansion, and intensification of economic activities place greater pressure on the need for sustainable water supply. The lackadaisical attitude towards water conservation by the public and private sector, as well as the general population contributed to Malaysia's poor result in the water index. The nation's water availability is threatened by damage to water catchment areas, diminishing peat swamp forests, river pollution, as well as poor sewage management.

Air pollution is very costly on many fronts from escalating health care cost, productivity loss, economic setbacks, diminishing natural capital, as well as increasing environmental stress. Malaysia's ambient air quality from 2000 to 2019 indicated pollution level above WHO's air quality guideline, added to the series of severe haze from uncontrolled fires from neighbouring countries as well as local peat fires. Concerted efforts to reduce greenhouse gas emissions have the benefit of improving air quality and should be made a national priority.

Malaysia has yet to fully embrace renewable energy on a scale needed to fulfil the international environment treaties that the Government has signed. The country's economic growth has been largely fuelled by its energy sector and electricity generation is still heavily reliant on fossil fuels, a huge contributor of Malaysia's greenhouse gasses (GHG) emission. The move towards renewable energy needs a comprehensive mechanism for assessing and improving electricity network connections, use, pricing, and renewable energy integration mechanisms. The Government needs to harmonise existing energy-related STI initiatives with the Green Technology Master Plan and improve energy governance in the country.

Integrated waste and resource management is vital to ensure the sustainability and equitability of Malaysia's transition into a high-income nation. The country's solidwaste has increased almost 98% over the past 17 years attributed to population increase, urbanisation, and massive industrialisation. Local solid waste management is still inefficient due to inadequate waste facilities and lack of funding and expert human capital, presenting a danger to Malaysia's natural asset through ground and water pollution as well as GHG emissions.

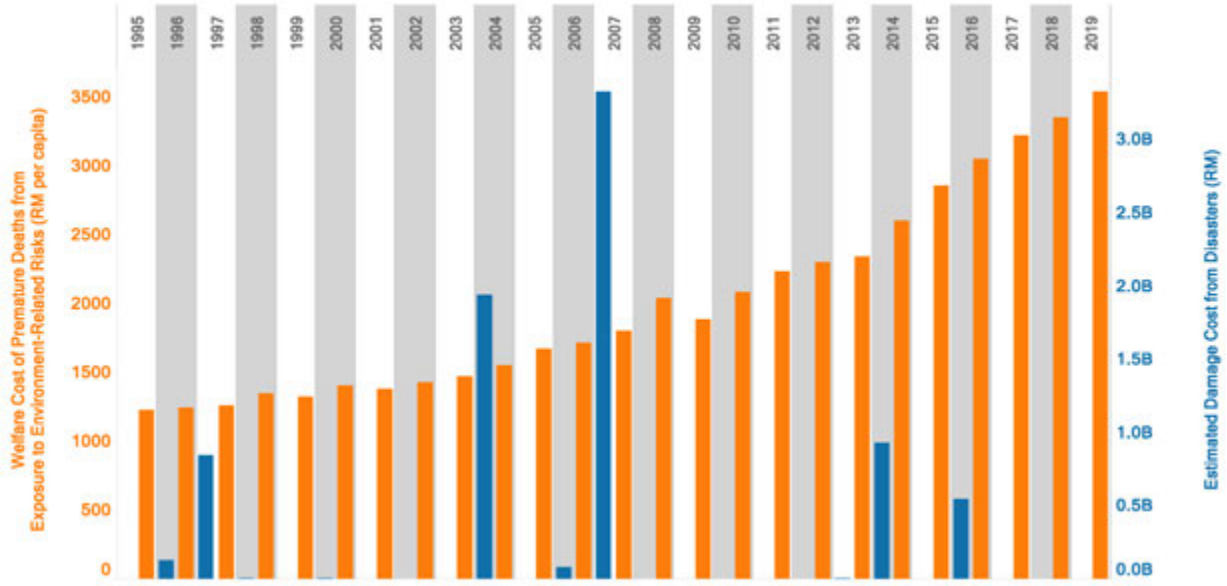
Resources can be utilised more effectively through refurbishment, remanufacturing, and recycling in a zero-waste circular economy (CE). CE technologies can generate energy, reduce GHG emission, and minimise the release of environmental toxins while also extracting nutrient from organic wastes to reduce dependency on artificial fertiliser. Sourcing of raw material for industry can also be reduced through material recovery and recycling, which is better for the environment as well as prolonging their lifecycle and stabilising the supply chain.

Ecosystem and biodiversity loss are a danger to the national food supply and not just to the sustainability of Malaysia's natural capital. Restoration of these losses should be prioritised as it not only affects the quality and sustainability of life for the *Rakyat*, but also can be a stumbling block in trade negotiations with countries that employ non-tariff barriers to their markets. The international market, particularly those from advanced economies, have begun denying the entry of products deemed to be from unsustainable sources. Increasing the renewable energy share in Malaysia's energy pie will not only help the country manage its resources better for future generations while conserving the environment, but it will also neutralise possible objection from economies with protectionist policies.

In short, any threat to the environment is a threat to the population. Figure 1.35 illustrates the escalating financial impact of environment-related issues on the *Rakyat*. Main disaster damage for Malaysia includes landslides, forest fires, tropical cyclones, floods and diseases such as cholera and dengue. About 75% of disaster damage in Malaysia results from flood-related disaster. For full list of disaster classifications, see Centre for Research on the Epidemiology of Disasters (CRED), 2009.

Over the last 24 years, Malaysia has cumulatively lost an estimated RM7.8 billion to environment-related disasters which does not include an estimated RM947.2 billion to welfare cost of environment-related premature deaths. That is an average loss of RM39.8 billion per year due to environment-related causes, which amounts to about 3% GDP loss in 2019 and 2020.

Climate change has intensified the rainfall and flooding threat in Malaysia, which also has a knock-on effect on water quality and availability. The average cost from annual flood damage was estimated to be around RM100 million in the 1980's, increasing almost ten-fold to RM915 million in the early 2000s. Urbanisation, extensive logging, deforestation of peat swamp forests as well as reclamation of mangroves are all contributing factors of the record-breaking floods in the past 30 years. Malaysia's cumulative sea level rise rate were almost double the global rate of 2-3mm per year, making the country vulnerable to the threat of rising sea-level driven by climate change.



Analysed by Sunway University Research Team

Figure 1.35: Estimated Cost of Environment-related Issues in Malaysia

The fragmentation of resources and authority over environmental protection and conservation is making it hard to ensure the sustainability of Malaysia's growth. Figure 1.36 shows the administration of environmental issues under the past six Malaysia Plans; the lack of a dedicated ministry for the environment led to a lack of political will to implement evidence-based policies that align nature's conservation with the country's progress.

Environmental protection and conservation need stronger institutional capacity and collaboration at Federal and State levels. For example, the proposed Malaysia Federal-State Commission for The Environment (MyFSCE) with the support of respective State River Basin Authorities (RBA) or Inter-State River Basin Authorities (I-SRBAs) and various state environment enforcement agencies to monitor and enforce environment protection.

Environmental credits for growth have been proposed to be a mechanism for mainstreaming natural assets management to increase terrestrial and marine protected areas up to 30% beyond the present; such measures need a cohesive Whole-of-Government and Whole-of-Society approach across Federal and State authorities as well as other private and non-profit partners. Compliance monitoring and enforcement across all the relevant agencies requires investment in monitoring technology as well as a robust data management and sharing framework in the form of a national digital ledger. Another advantage of setting up a national digital ledger in systematic and secure data gathering and sharing across all arms of the Government to strengthen policy administration for a better outcome for the people.

6th MP (1990 -1995)	7th MP (1996 - 2000)	8th MP (2001 - 2005)	9th MP (2006 - 2010)	10th MP (2011 - 2015)	11th MP (2016 - 2020)
Ministry of Science, Technology and Environment	Ministry of Science, Technology and Environment	Ministry of Science, Technology and Environment	Ministry of Science, Technology and Innovation	Ministry of Science, Technology and Innovation	Ministry of Science, Technology and Innovation
			Ministry of Natural Resources and Environment	Ministry of Natural Resources and Environment	Ministry of Environment and Water
Ministry of Energy, Telecommunications and Posts	Ministry of Energy, Communications and Multimedia	Ministry of Energy, Telecommunications and Posts	Ministry of Energy, Water and Communications	Ministry of Energy, Green Technology and Water	Ministry of Energy and Natural Resources

Figure 1.36: The Environment Portfolio Throughout Six Malaysia Plans (1990-2020)

Unlocking the Future

In the 1990s, Malaysia was known as a robust Asian Tiger economy underpinned by a strong manufacturing and service sectors. However, over the years, increasing competition from larger regional economies has eroded Malaysia's competitiveness. At the same time, the failure to protect the environment and biodiversity has adversely impacted the environment which has a knock-on effect on the quality of life of the Rakyat. This necessitates the decisive action at the highest levels to ensure the nation's progress towards equitable, inclusive and sustainable growth.

There are a number of gaps in Malaysia's STI ecosystem that prevents the fulfilment of the STI initiatives to move the nation to become an innovation- and knowledge-driven economy, one of which is the lack of alignment between the numerous STI initiatives with the socio-economic and environmental development of the country. Malaysia needs a focused approach in setting the STI priorities and direction across multiple agencies and economic sectors. The governance for STI and socio-economic development must be transparent with appropriate accountability and coordination between the Federal and State authorities.

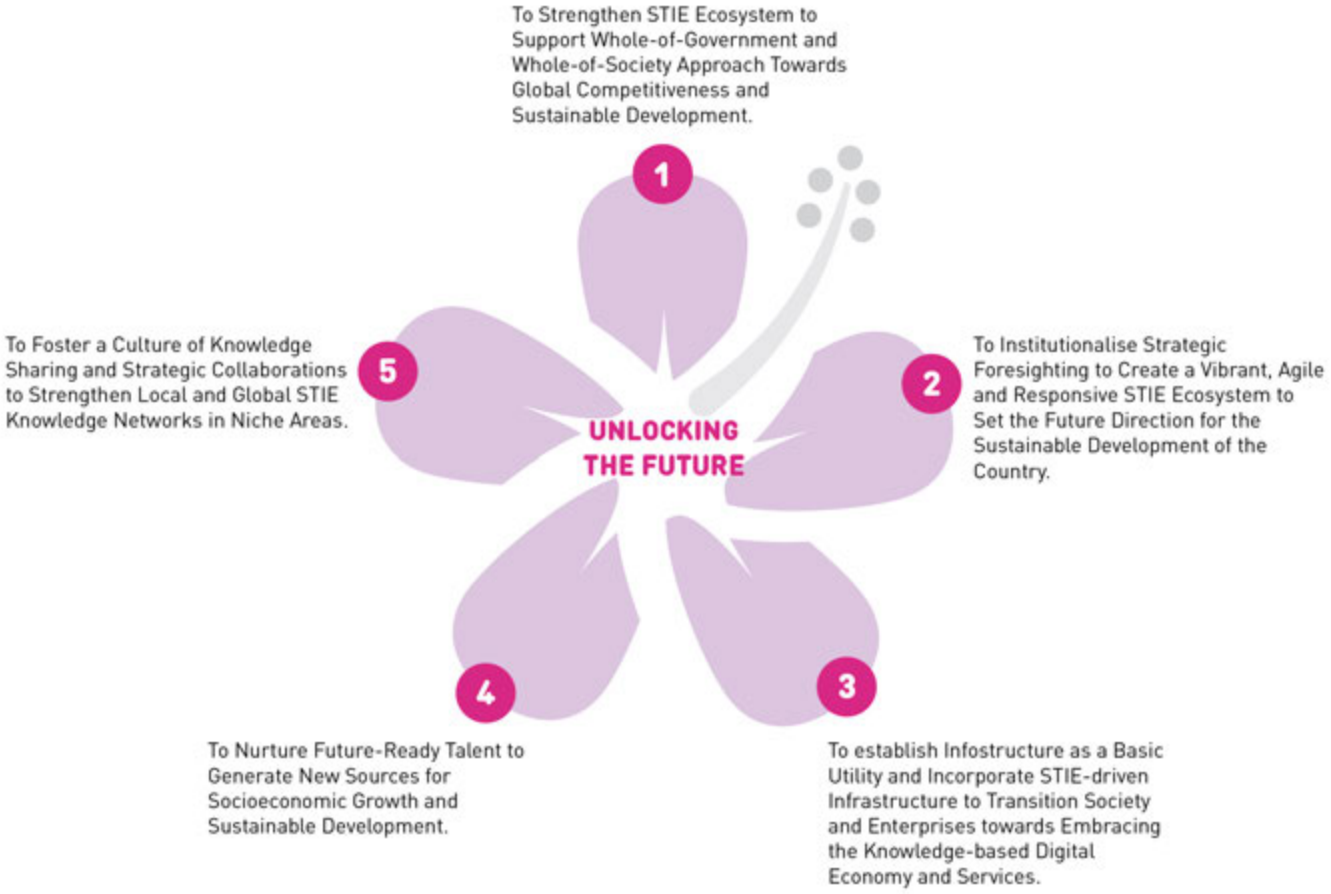


Figure 1.37: Recommendations for Science Outlook 2020

RECOMMENDATION 1

To Strengthen STIE Ecosystem to Support Whole-of-Government and Whole-of-Society Approach Towards Global Competitiveness and Sustainable Development.

There is no clear institutional champion to provide direction, monitor, evaluate, track impact, and put in place a continuousimprovement cycle to the national STIE ecosystem. The absence of a champion results in fragmented policy directives leading to ineffective and time-consuming implementation of strategies, programmes and initiatives. Currently, there are too many institutions with overlapping roles and responsibilities, resulting in ineffective utilisation of limited resources. Additionally, unfocussed fiscal and non-fiscal incentives fail to target core sectors of the economy due to constant policy changes, coupled with inconsistent funding for large scale and long-term STI initiatives.

The STIE ecosystem management should be strengthened, streamlined and transformed through a WOG and WOS approach to ensure formulation and implementation of evidence based STIE policies. This will require the Government to implement seamless planning, coordination, and monitoring of STIE-related issues by nurturing a high level of transparency and integration of interdependency across ministries and agencies with different portfolios and jurisdictions. Collaboration with civil society organisation, by including them at the decision-making level of STIEwould enhance the process of engagement and buy-in from community and industry-based groups who are conduits to the final users of the products and services.

Actionable Strategies

1

Create a robust STIE management and monitoring system for impact tracking and e-governance through establishment of a national digital governance ledger.

2

Create specific national digital registries for healthcare, environmental and natural assets (physical & non-physical) and intellectual capital to name a few, for better management, monitoring, analyses and decision making.

RECOMMENDATION 2

To Institutionalise Strategic Foresighting to Create a Vibrant, Agile and Responsive STIE Ecosystem to Set the Future Direction for the Sustainable Development of the Country.

The nation lacks integrated and coordinated national foresighting planning to ensure sustainable socioeconomic development across the country despite the various nationalplans and visions such as the National Economic Policy and Vision 2020. To ensure Malaysia remain competitive and adaptive to future challenges, foresight capacity needs to be institutionalised within the Government using a cross-cutting platform that can harmonise the strategic planning of all ministries.

Actionable Strategy

1

Formation of an independent "Foresight entity" to develop Malaysia's overall STIE ecosystem to be agile, adaptive and responsive to address global challenges and provide global leadership in key strategic areas of importance, especially from the perspective of the four Ministerial clusters namely, Infrastructure, Defence, Education and Economy.

RECOMMENDATION 3

To establish Infostructure as a Basic Utility and Incorporate STIE-driven Infrastructure to Transition Society and Enterprises towards Embracing the Knowledge-based Digital Economy and Services

The global economy has been transformed by the information revolution and this is changing every facet of the nation.However, Internet connectivity and quality in many parts of the country remain weak, particularly in areas where the poor and marginalised communities live despite the availability of sufficient capacity to supply these communities. Expanding access and other digital infrastructural support is a powerful catalyst to empower everyone the opportunity to participate in the global digital economy in the spirit of the SPV2030.

Actionable Strategies

1

To include fixed broadband infostructure services as a basic utility, from deployment, management and maintenance of high-quality services in all future mid- to low-level real estate development projects. The process should involve democratisation of infostructure services by breaking up extant monopolies held by any single party to a system that involves an open market in the supply and maintenance of infrastructures and infostructure services.

2

To ensure the physical and natural ecosystems adopt advanced digital technologies to pre-empt, manage and mitigate man-made and natural disasters and risks. Ensuring that our valuable natural resources continue to yield to the needs of our national development in a sustainable manner requires that protection, preservation and enhancement of natural infrastructure is accorded high priority since the wellbeing of society and the planet is at stake.

RECOMMENDATION 4

To Nurture Future-Ready Talent to Generate New Sources for Socioeconomic Growth and Sustainable Development.

Knowledge and intellectual capital growth are not keeping up with the needs of the industry and the nation in critical areas. Talent in Malaysia possess high general skills but lacks multidisciplinary and specialised skills, as well as leadership and entrepreneurial acumen. Industries in Malaysia rely heavily on foreign technology and know-how to upgrade their operations. The level of technology and knowledge transfer in many sectors among local and foreign firms are relatively low and opportunities to acquire and upgrade appropriate skills are scarce, especially for marginalised communities. The talent of the future must be equipped with depth of knowledge and specialist industry competencies, resilient and multi-versed to be able to communicate and work across disciplinary areas and be ready to constantly upgrade and re-skill over their lifetime. They also need to be well- schooled in societal values such as ethics and morality to tackle today's problems in ways that ensure they do not deplete and sacrifice the physical and natural endowments needed by future generations.

Actionable Strategies

1

To formulate and institutionalise a Talent Masterplan based on the 10-10 *My*STIE Framework and develop a clear competency framework that is co-developed by government, academia, industry players, and civil society groups for future-ready talent.

2

To establish an occupation tracking mechanism to monitor technical school leavers and graduates as they enter the workforce and monitor their career trajectories over time. This system would identify and project STIE-related jobs, the needed supply and skills of the future for Malaysia and adjust training and learning to meet the evolving needs of the economic, social and environmental sectors.

3

To enhance the curriculum of local training institutes for policy and diplomacy (i.e. Institute of Diplomacy and Foreign Relations (IDFR) and National Institute of Public Administration (INTAN)) to incorporate STIE-knowledge as part of existing curriculum and provide training to nurture civil servants who will then graduate as multi-versatile citizens, capable of responding to market intelligence with appropriate knowledge of global standards and best practices for advocating sustainable development. There is a need to acculturate civil servants to be good advocates and ambassadors of our rich biodiversity, natural ecosystem, and environmentally friendly industries and keep abreast with key emerging issues of interest to Malaysia.

RECOMMENDATION 5

To Foster a Culture of Knowledge Sharing and Strategic Collaborations to Strengthen Local and Global STIE Knowledge Networks in Niche Areas.

The quadruple helix of government-universities-industry-public is weak in knowledge sharing, collaboration, and actionable coordination for sustainable development of communities and enterprises. An STIE ecosystem with a strong knowledge sharing culture will enable marginalised communities to access information, knowledge, technology,innovation and other resources to improve their quality of life. This vibrant STIE ecosystem will enable micro- and SMEs to build strong dynamic capabilities through technology and knowledge transfer to support a strong global supply chain.

Actionable Strategy

1

Strengthen regional innovation centres in the localities across the country to drive multi-stakeholders' collaboration between regional Corridors, Science/Technology Parks, technology incubators, universities, institutions of learning/training research institutes, industry and community organisations to strengthen and enable technology-based start-ups, communities and, micro and SMEs to develop the local economy with a global outlook while ensuring the sustainability of the physical environment and natural resources.

In summary, strategic planning of the STIE ecosystem is critical to ensure a balance between economic development, social progress and environmental sustainability. The nexus between all three pillars is imperative for a holistic and sustainable progress that can be accessed by everyone today and future generations aligned to the SPV2030.

"The ASM Science Outlook 2020 initiative is an important initiative. It aims to mainstream Science, Technology and Innovation Policy recognizing its importance as a catalyst for increased productivity, competitiveness and resilience as Malaysia aims to transition to an innovation led economy, with growth that is inclusive, and sustainable"

–Ms Smita Kuriakose, World Bank Group (Malaysia)

"The Science Outlook 2020 commendably brings together empirical and benchmarking data as a foundation for future policies. PenDaPaT, as an NGO advocating evidence-driven policy development in higher education underscores the need for new policies, even STIE, to consider society and sustainability as the core concerns "

–Malaysian Society for Higher Education Policy & Research Development (PenDaPaT)

Science Outlook 2020
Unlocking the Future

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